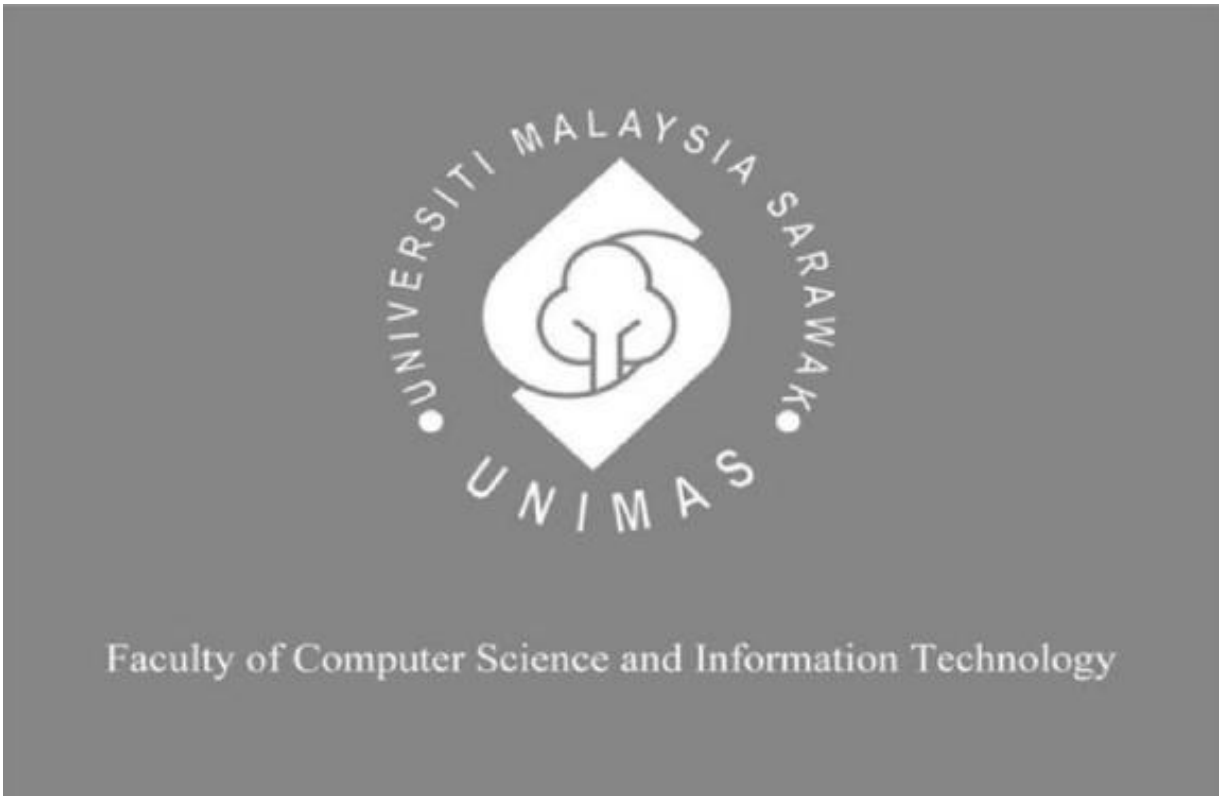

OCEAN EXPLORER: AN INTERACTIVE EDUCATIONAL MOBILE GAME ABOUT MARINE LIFE AND ECOSYSTEMS AWARENESS

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This project is submitted in partial fulfillment of
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ABSTRACT

Marine ecosystems are vital for Earth's biodiversity and human survival, yet there is still lack of conservation awareness, particularly among adults. This project aims to address this gap by developing "Ocean Explorer," an interactive 2D mobile game designed for adults aged 18 to 25. By utilizing game-based learning principles and gamification elements, the game incorporates quizzes, puzzles, achievements, and exploration mechanics to encourage engagement and knowledge retention about marine life and ecosystems. Agile methodology is used to ensure a structured approach. The significance of this project lies in its potential to transform traditional teaching methods, thus improving the accessibility and involvement of adults in marine biodiversity.

ABSTRAK

Ekosistem marin adalah penting untuk biodiversiti Bumi dan kelangsungan hidup manusia, namun masih terdapat kekurangan kesedaran pemuliharaan, terutamanya di kalangan orang dewasa. Projek ini bertujuan untuk menangani jurang ini dengan membangunkan "Ocean Explorer", permainan interaktif mudah alih 2D yang direka untuk orang dewasa berumur 18 hingga 25 tahun. Dengan menggunakan prinsip pembelajaran berasaskan permainan dan elemen gamifikasi, permainan ini menggabungkan kuiz, teka-teki, pencapaian dan mekanik penerokaan untuk menggalakkan penglibatan dan pengekalan pengetahuan tentang hidupan marin dan ekosistem. Metodologi Agile digunakan untuk memastikan pendekatan berstruktur. Kepentingan projek ini terletak pada potensinya untuk mengubah kaedah pengajaran tradisional, justeru meningkatkan kebolehcapaian dan penglibatan orang dewasa dalam biodiversiti marin.

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LIST OF ABBREVIATIONS

2D	- Two-Dimensional
GBL	- Game-Based Learning
CP	- Contribution Points
OS	- Operating System
CPU	- Central Processing Unit
GPU	- Graphics Processing Unit
RAM	- Random Access Memory

CHAPTER 1: INTRODUCTION

1.1 Introduction

Marine ecosystems were crucial to Earth's biodiversity and human survival, yet they faced numerous threats due to human activities, such as pollution, overfishing, and climate change (Chatterjee, S., 2017). Despite their importance, awareness about marine conservation often remained limited among adults, as traditional educational method using books and pictures frequently failed to engage this audience. This lack of engagement resulted in a significant gap in the understanding and appreciation of marine ecosystems, which was essential for taking care of our environment.

In contrast, Game-Based Learning (GBL) offered an advantage by motivating adults to learn through enjoyable and interactive elements that made acquiring knowledge more enjoyable. Through carefully designed gameplay and engaging game mechanics, game-based activities could sustain interest and promote active involvement (Lewis et al., 2012; Swink, 2008, as cited in Hartt et al., 2020). This method was suitable for complex subjects like marine ecosystems, as it made them easier to understand and retain knowledge.

Gamification, defined as the integration of game elements into non-game settings to enhance engagement and motivation, was an effective strategy in education (Huang & Soman, 2013). By incorporating gamification principles such as instant feedback and rewarding achievements, learners were encouraged to engage actively with the game. This approach aligned with the goal of making educational experiences enjoyable while fostering curiosity and sustained interest in marine ecosystems.

In this project, an interactive 2D educational game, Ocean Explorer, was developed to help adults aged 18 to 25 learn about marine life and ecosystems. The game included gamified elements such as puzzles, quizzes, and achievements, which encouraged exploration

and rewarded players for learning about different marine species. As players progressed, they unlocked new marine creatures, reinforcing their knowledge and fostering an early interest in marine conservation.

1.2 Problem Statement

Nowadays, most methods used to teach about the ocean and marine life relied on content, such as books and pictures, which limited engagement and interactivity. These traditional approaches often had difficulty capturing people's interest, resulting in lower knowledge retention and enthusiasm for learning. Although some educational games existed to teach about the ocean, they generally were for a younger audience and also lacked dynamic interactive features and elements that could make learning more engaging and memorable for adult players.

There was a need for a technology-driven game that educated players about marine ecosystems through an engaging and interactive experience. By incorporating gamified features like exploration-based gameplay, instant feedback, visually captivating graphics, and challenges, such a game could effectively engage adult players. These elements would allow players to interact directly with virtual ocean environments, discover marine species, and learn through an immersive journey, bridging the gap left by old methods and existing educational games.

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1.3 Aims and Objectives

The objectives of this project were:

1. To develop an interactive 2D mobile game that focused on marine life and ecosystems.
2. To implement gamification elements such as quizzes, puzzles, achievements, and feedback.
3. To test and evaluate the effectiveness of the game in educating users about marine life and ecosystems.

1.4 Scope

This project focused on providing an educational tool for adults aged 18 to 25, aiming to help them gain fundamental knowledge about marine life and ecosystems. The scope was limited to a 2D Android mobile game that used exploration, achievements, quizzes, and puzzles, featuring only a limited selection of marine life, without aiming to replicate real-world marine environments or scientific simulations. The development scope included using Unity for designing and building the game environment and mechanics, Visual Studio Code for scripting and debugging, and Canva for creating visual assets like storyboards and interface elements. Additionally, open-source assets were sourced from platforms like Canva, UnityAssetStore, and Itch.io.

1.5 Brief Methodology

For the development of this project, the Agile methodology was used to ensure a structured and iterative approach to game development. Agile was selected for its flexibility, adaptability, and emphasis on continuous improvement, which were particularly suitable for solo development. Given that this project did not involve a team, the methodology was adapted to fit an individual workflow, enabling streamlined decision-making and efficient task management. Figure 1.1 illustrates the Agile model.

Figure 1.1: Agile Phases (From Putri M.A.M., 2022)

The game development project was organized into several key phases, each with specific objectives and timelines. The first phase, the Requirements Phase, focused on defining the game's objectives and features. This included identifying the target audience, establishing clear game objectives, outlining the content, and determining gameplay elements. This phase was expected to take approximately 4 weeks. The next Design Phase emphasized creating the game's flowchart and storyboard. This phase was crucial for visualizing the game's flow and interactions, ensuring a clear direction for development. It was projected to take about 6 weeks. The Development Phase followed, encompassing the actual creation of

the game, including coding and asset integration. As a solo developer, tasks were approached incrementally, focusing on one feature at a time. This phase was anticipated to require approximately 8 weeks. In the Testing Phase, approximately 8 weeks were dedicated to evaluating the game's usability and playability, ensuring it functioned as intended. Feedback from playtesting was used to identify and resolve any issues. The Deployment Phase took 1 week, during which the game was refined based on user feedback and prepared for submission. Finally, the Review Phase, lasting 1 week, involved reviewing the game's overall success against predefined objectives and final report preparation.

The Agile methodology provided the flexibility to adapt plans based on progress and feedback, which was essential for solo developers juggling multiple roles. By breaking down the project into manageable stages and focusing on iterative development, Agile ensured continuous improvement and effective time management throughout the game's creation.

1.6 Significance of Project

The significance of this project lay in its ability to make learning about marine life and ecosystems more engaging and accessible for adults through a gamified approach. By providing an interactive and enjoyable educational tool, this project encouraged a deeper understanding and retention of knowledge about marine conservation. It contributed to raising awareness of the importance of marine biodiversity and the environmental challenges it faced, thereby empowering adults to take informed steps in supporting conservation efforts and sustainable practices.

1.7 Project Schedule

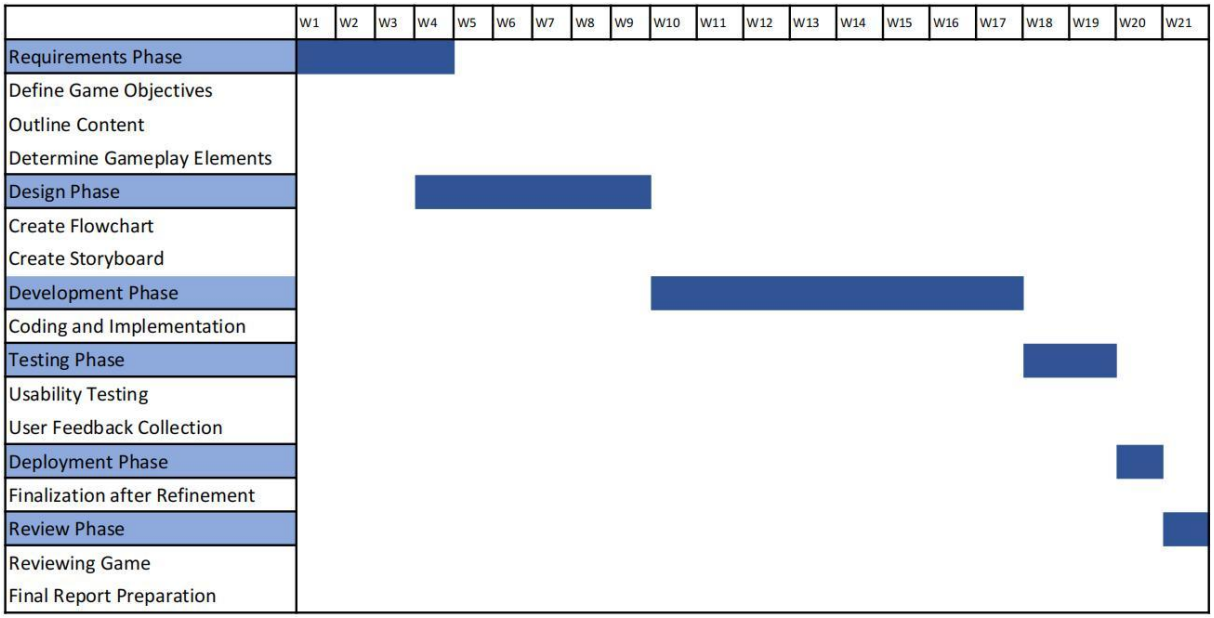

Figure 1.2: Gantt Chart of Project Schedule

1.8 Expected Outcome

At the end of this project, an educational game designed to teach adults aged 18 to 25 about marine life and ecosystems was developed. The game incorporated gamification elements such as quizzes, puzzles, and achievements, making the learning process more fun and engaging. Through interactive gameplay, users were able to explore marine environments, discover various species, and gain a deeper understanding of ecosystems, effectively addressing the limitations of traditional teaching methods and existing educational games.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter provided a brief overview of Game-Based Learning (GBL) and gamification, which served as foundational concepts for enhancing user engagement and educational outcomes. Following this, three ocean-related game applications were reviewed. A comparative analysis was then presented in a table format, highlighting the key features of each game. Finally, the chapter discussed how the insights gained from this review could be applied to the design and development of Ocean Explorer.

2.2 Game-Based Learning (GBL)

Game-Based Learning (GBL) was an innovative educational approach that employed games to facilitate learning and enhance student engagement (Hafeez, 2022). In contrast to traditional teaching methods, which often relied on passive information delivery, GBL actively involved learners in the educational process through interactive gameplay. This distinction was crucial, as GBL leveraged the unique capabilities of video games, particularly serious games, to create an engaging learning environment. Such an approach transformed the educational experience into a dynamic interaction, enabling students to explore, experiment, and apply concepts effectively. Consequently, this enhanced their motivation and facilitated the overall learning process (Kaldarova et al., 2023).

Several key elements contributed to the effectiveness of GBL, including game mechanics, interactivity, and feedback. Game mechanics referred to the rules and systems that governed gameplay, which included challenges, rewards, and levels designed to motivate learners to progress. Interactivity was essential, as it allowed students to engage actively with the content, fostering a sense of self-directed learning. Additionally, feedback mechanisms

provided immediate responses to learners' actions, assisting them in understanding their mistakes and successes in real-time (Alotaibi, 2024). Collectively, these components created an immersive learning environment that encouraged exploration and critical thinking.

The significance of GBL in modern education arose from its ability to engage students and actively cultivate a passion for learning. Traditional teaching methods frequently failed to captivate students' interest, resulting in disengagement and lowered academic performance. According to Kaldarova et al. (2023), GBL effectively addressed these challenges by offering interactive, enjoyable, and immersive experiences that motivated students to participate actively in their learning. This shift towards GBL was driven by the necessity to develop more effective educational experiences that resonated with the needs and preferences of today's learners.

Research consistently demonstrated that GBL was more effective than traditional methods. According to Hafeez (2022), numerous studies had shown that GBL could significantly enhance students' critical thinking skills, problem-solving abilities, and overall academic performance. The interactive nature of GBL encouraged immediate feedback and adaptive learning experiences, which were often absent in traditional educational settings. This effectiveness was further supported by Alotaibi's (2024) findings, which indicated that GBL promoted cognitive, social, and emotional development in young learners.

2.3 Gamification

Gamification was the integration of game design elements into non-game contexts to enhance user engagement and motivation. It involved applying game mechanics and principles within educational environments, aiming to leverage the motivational aspects of games to improve learning experiences and outcomes (Huang et al., 2023). This concept

gained influence in the early 2010s and had since been recognized as a significant approach across various educational contexts (Thurairasu, 2022).

The key components of gamification encompassed points, badges, leaderboards, levels, and challenges. These elements were designed to motivate learners by providing immediate feedback, fostering competition, and creating a sense of achievement (Huang et al., 2023). For example, platforms such as Kahoot! utilized points and leaderboards to establish a competitive environment that actively encouraged student participation in the learning process (Thurairasu, 2022). This approach made learning more fun while also helping students understand the material better. Furthermore, gamification could integrate storytelling and role-playing elements, which served to strengthen the emotional connection students had with the content. This was particularly effective in language learning contexts, where interactive narratives facilitated the practice of communication skills in a contextualized manner (Najjar & Salhab, 2022).

The rationale for implementing gamification was rooted in its capacity to engage digital natives who were accustomed to interactive and technology-driven environments. Thurairasu (2022) stated that by incorporating game elements into educational frameworks, educators could create more dynamic and appealing learning experiences. Empirical research indicated that gamification could significantly enhance motivation and engagement among students, as evidenced by studies demonstrating increased participation rates in gamified learning environments (Huang et al., 2023). Additionally, gamification served to bridge the gap between traditional educational methodologies and the expectations of modern learners, positioning it as a vital tool for educators seeking to improve student engagement and learning outcomes.

Compared to traditional educational methods, gamification was considered effective due to its positive impact on learning outcomes. Research had shown that gamification could lead to elevated levels of student engagement, motivation, and academic performance. The interactive nature of gamified learning environments encouraged students to take ownership of their educational journey. A systematic review conducted by Huang et al. (2023) found that gamified project-based learning significantly enhanced students' learning experiences and motivation, resulting in improved academic performance. Furthermore, gamification promoted the development of essential skills such as problem-solving, collaboration, and critical thinking, which were crucial for success in the 21st century (Najjar & Salhab, 2022)..

2.4 Review of Ocean-Related Game Application

2.4.1 Dinosaur Submarine

Dinosaur Submarine was an application developed by Yateland (Yateland, 2023) that targeted children aged 0 to 5 years. The primary objective of the developer was to create an educational game that effectively combined learning and entertainment for preschool children. Yateland aimed to inspire children to learn through play while providing educational value through hands-on experiences. Figure 2.1 shows the interfaces from Dinosaur Submarine.

In Dinosaur Submarine, players navigated submarines through various ocean environments, including the Antarctic, tropical islands, and underwater volcanoes. Players could select their preferred ocean environment and choose the submarine they wished to use for exploration. Throughout their journey, players could discover marine animals, shipwrecks, and buried treasures.

To navigate the ocean, players interacted with the game by tapping on their device's screen in the desired direction. Upon encountering marine life, such as fish, coral, and sea

anemones, players could engage with these elements by clicking on them. A text box displaying the name of the marine life would appear, and players could click on it to listen to an audio voiceover that pronounced the name and provided interesting facts about the marine organism.

While exploring, players could also interact with buried broken treasures, which they could collect and assist marine life in need. Upon completing their exploration, players were tasked with piecing together the broken treasure to form a complete artifact.

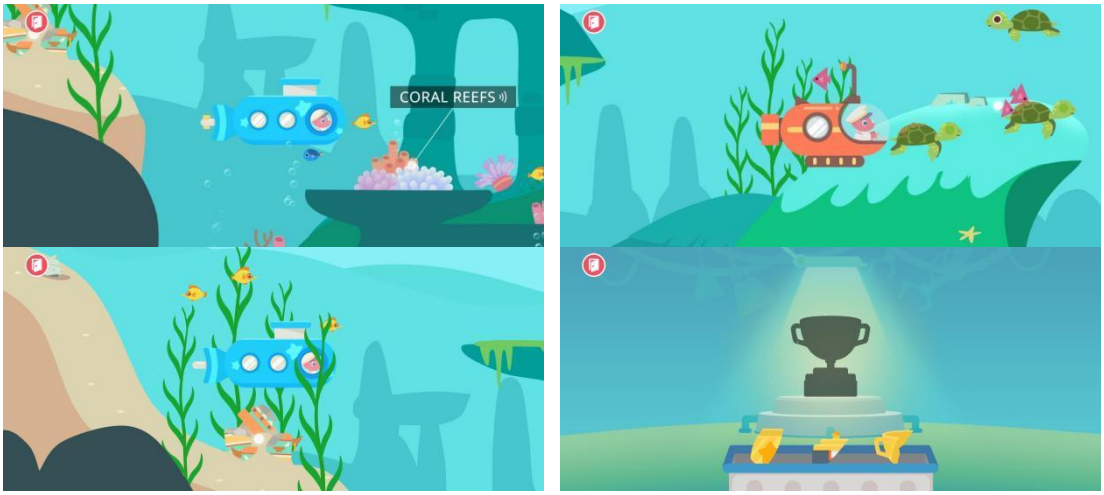

Figure 2.1: Interfaces from Dinosaur Submarine (Yateland, 2023)

2.4.2 Splash: Fish Sanctuary

Splash: Fish Sanctuary was an application developed by Runaway Play (Runaway Play, 2022). The developer did not specifically target any particular audience, making it accessible to both children and adults. The primary objective of the developer was to promote conservation and raise awareness of the natural environment. To achieve this, the game aimed to provide a relaxing experience by allowing players to nurture and decorate an ocean reef, collect and care for exotic fish, participate in events, and document their discoveries within a captivating underwater world. Figure 2.2 shows the interfaces from Splash: Fish Sanctuary.

In Splash: Fish Sanctuary, players were guided by a turtle character that instructed them on how to feed and grow fish, unlock new environments, and complete various fish-related events. The game featured a wide variety of accurately depicted fish species, and players could document their discoveries in an in-game resource known as the Aquapedia.

Players were tasked with feeding and nurturing fish until they reached adulthood, at which point they could be released to obtain drop items. These items could be used to level up and create new fish species. As players progressed and leveled up, they earned keys that unlocked new areas and granted access to additional species of fish.

Newly obtained fish were displayed in the Aquapedia, where players could view their discovered species, create new fish, and access facts about each fish. To unlock the facts page, players had to complete specific tasks assigned on that page. The facts page provided detailed information, including common names, scientific names, size, region, images of the fish with labeled features, and conservation facts related to each species.

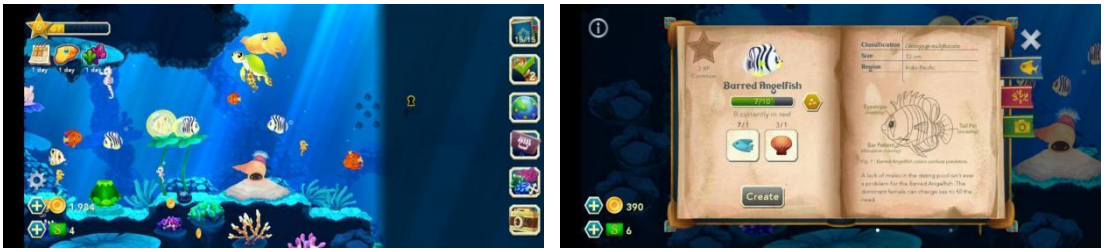

Figure 2.2: Interfaces from Splash: Fish Sanctuary (Runaway Play, 2022)

2.4.3 FathomVerse

Institute (FathomNet, 2024). The developer did not specifically target any particular audience, making it accessible to both children and adults. The objective of the developers of FathomVerse was to enhance the understanding and monitoring of marine life by utilizing player engagement to train AI models, thereby addressing knowledge gaps in ocean biodiversity. To achieve this, the game aimed to provide an interactive community science experience that allowed players to engage with real ocean images, contributing to the

discovery and understanding of marine life while fostering a passion for ocean exploration. Figure 2.3 shows the interfaces from FathomVerse.

In FathomVerse, players embarked on a journey guided by an engaging interface that allowed them to interact with real ocean imagery collected by researchers and robots. The gameplay featured minigames that challenged players to discover and identify real ocean animals, honing their skills in recognizing nearly 50 different groups of marine life. As players progressed, they could save their favorite images and create a personal gallery, showcasing the incredible biodiversity they encountered.

Players were tasked with exploring along the ocean current, where they could select up to three marine animals as their mission from the library. In the library, players could view the marine animal's common name, scientific name, labeled body structure, real images, and confusing look-alikes. During exploration, players were tasked with finding the mission animals. They needed to tap the screen to release a pulse that revealed hidden animals. To exit the exploration, players had to press the surface button. Contribution Points (CP) were awarded for each animal that players revealed and identified. CP could be used to level up and receive awards.

Figure 2.3: Interfaces from FathomVerse (FathomNet, 2024)

2.5 Comparison of Ocean-Related Game Application

Table 2.1: Comparison of Ocean-Related Game Application

Application/ Features	Dinosaur Submarine	Splash: Fish Sanctuary	FathomVerse
Target Audience	For children aged 0–5	For all ages (children and adults)	For all ages (children and adults)
Exploration Mechanic	Navigate through ocean environments by tapping the screen	Level up and get key to unlock new environment	Explore along ocean currents and use pulses to reveal hidden animals
Educational Information Provided	Provides common name and basic facts of marine life through audio voiceovers when players press on the name	Provides common name, scientific name, size, region, conservation facts, and labeled features of marine life in the Aquapedia	Provides common names, scientific names, labeled body structures, real images, and confusing look-alikes of marine life in the library
Game-Based Learning Elements	Provides exploratory learning through interaction with marine life, introducing common names and facts	Combines nurturing tasks with conservation education, encouraging players to care for and document marine species	Integrates real-world data to educate players on marine biodiversity while contributing to marine research
Gamification Elements	Players collect treasures and complete artifact puzzles, encouraging exploration and learning	Includes points, keys, levels, and unlockable features to encourage progress and exploration in the game	Features CP that use to level up, awards, and mission-based challenges to encourage engagement

2.6 Discussion of Proposed Application

The comparison of existing applications in Table 2.1 highlighted diverse approaches to teaching marine life through games. Each application—Dinosaur Submarine, Splash: Fish Sanctuary, and FathomVerse—addressed specific educational and entertainment objectives tailored to their target audiences. Analyzing these applications had led to the identification of key features to incorporate into my own game, Ocean Explorer, which was designed to meet the needs of adult learners aged 18 to 25.

The primary objective of Ocean Explorer was to develop an interactive 2D mobile game centered on marine life and ecosystems. The game would integrate gamification elements such as quizzes, puzzles, achievements, and feedback mechanisms, and would undergo testing to evaluate its effectiveness in educating users. Ocean Explorer would provide a balanced combination of exploration, interactivity, and learning. Through an adaptive and immersive gameplay structure, players would be encouraged to actively engage in the discovery of marine life and its ecological significance.

To facilitate this, Ocean Explorer would implement an exploration-based gameplay mechanic that allowed players to navigate the environments. This feature would enable players to interact with marine life in their natural habitats, fostering a deeper understanding of ecological relationships and the complexities of marine ecosystems. Through these interactions, players would unlock encyclopedic entries that provided detailed information about the marine species they encountered.

Furthermore, the educational content within Ocean Explorer would encompass common name, scientific name, physical features, dietary habits, fun facts, and real-world images of marine life. This comprehensive approach would ensure that players acquired a well-rounded understanding of the species they studied.

In terms of Game-Based Learning elements, players would engage with marine life to unlock encyclopedic entries, reinforcing their learning through direct interaction. This hands-on approach was designed to enhance retention and comprehension of marine biodiversity.

Additionally, the game would incorporate advanced gamification elements to improve user engagement and knowledge retention. Unlike existing applications, Ocean Explorer would feature interactive quizzes and challenges that assessed players' knowledge levels. This adaptive learning approach would provide immediate feedback, reinforcing concepts and ensuring that players could effectively retain knowledge. By rewarding players for their achievements, the game would sustain motivation and encourage ongoing interaction with the educational content.

2.7 Conclusion

This chapter had reviewed ocean-related game applications, including Dinosaur Submarine, Splash: Fish Sanctuary, and FathomVerse. Through the analysis of these applications, key features had been identified that could enhance the development of the proposed game, Ocean Explorer, which targeted adult learners aged 18 to 25. The insights gained from this review highlighted the importance of incorporating effective GBL principles and gamification strategies into Ocean Explorer to create a more immersive and educational experience. By emphasizing exploration, comprehensive educational content, and interactive quizzes, Ocean Explorer aimed to provide an engaging learning environment that fostered a deeper understanding of marine ecosystems. Ultimately, the goal was to encourage players to appreciate marine biodiversity and promote conservation awareness.

CHAPTER 3: REQUIREMENT ANALYSIS AND DESIGN

3.1 Introduction

This chapter discusses the development process of Ocean Explorer, utilizing the Agile methodology and a Kanban board to manage tasks. It covered the game's functional, non-functional, and technical requirements as part of the requirements phase. The chapter also described the design phase, which included a flowchart illustrating gameplay and a storyboard visualizing narrative flow and key elements.

3.2 Agile Methodology

As outlined in Chapter 1, the Agile methodology was utilized for the development of this project due to its adaptability, iterative nature, and suitability for solo development. This approach allowed for efficient task management, continuous feedback incorporation, and iterative improvements throughout the project lifecycle. This was achieved through the use of a simple Kanban board for task tracking, which categorized tasks into phases such as "To-Do", "Doing", and "Done" (Alaidaros et al., 2021). This provided visual representation that helped monitor progress and maintain focus on priorities. Regular reviews with the supervisor established feedback loops, ensuring continuous refinement and alignment with project goals.
In the Requirements Phase, all necessary elements for developing Ocean Explorer were analyzed and identified. Chapters 1 and 2 defined the educational objectives, analyzed existing systems, and explored relevant concepts like Game-Based Learning and gamification. These insights laid the foundation for Chapter 3, which formalized the functional, non-functional, and technical requirements.

The Design Phase focused on transforming these requirements into a structured game framework. This involved creating a flowchart to outline the gameplay sequence and a

storyboard to visualize the narrative flow and key gameplay elements. Tools like Canva were utilized to develop intuitive interfaces and gameplay interactions. This phase ensured the design was aligned with the project's objectives and provided a clear direction for development.

The Development and Testing phases were discussed in Chapter 4, covering the implementation of game mechanics, asset integration, and the evaluation of usability and playability. Testing ensures that the game functioned as intended and met its objectives. Finally, Chapter 5 focused on the Deployment and Review phases, which involved refining the game based on user feedback, preparing it for submission, and assessing its success against predefined objectives, including the creation of a final report.

3.3 Requirements

3.3.1 Functional Requirements

Below was the list of functional requirements for the proposed application:

- The game had to allow players to navigate through marine environments using touch controls, such as a joystick for movement and buttons for interaction.
- The game provided information about marine species, including their common name, scientific name, physical features, dietary habits, fun facts, and real-world images of marine life.
- The game had an encyclopedia where players could access back the information of the marine life.
- The game included a quiz feature that allowed players to assess their retention of the information they had learned.

- The game included achievements that players could unlock by completing specific tasks.
- The game included a quiz feature that allowed players to assess their retention of the information they had learned.
- Players were able to pause the game at any time and resume from the most recent checkpoint.
- The game allowed players to stop the game at any time and return to the main menu or exit the application completely, with the option to save their progress.

3.3.2 Non-Functional Requirements

Below was the list of non-functional requirements for the proposed application:

- The game had an intuitive user interface that was easy to navigate for players.
- The game was compatible with Android smartphones.
- The game was able to run consistently with minimal or zero crashes.

3.3.3 Technical Requirements

3.3.3.1 Hardware Requirements

Table 3.1: Hardware Requirements to Develop Ocean Explorer

Hardware	**Description**
Acer Nitro V15	Laptop was required to install software for developing the game Ocean Explorer. • OS: Windows 11 Home CPU: AMD Ryzen 5 7535HS • GPU: NVIDIA GeForce RTX 2050

	• RAM: 16GB • Storage: 512GB
Xiaomi 14T	Android smartphone was required to install and test the functionality of Ocean Explorer. • OS: Android 14, HyperOS • RAM: 16GB • Storage: 512GB

3.3.3.2 Software Requirements

Table 3.2: Software Requirements to Develop Ocean Explorer

Software	**Description**
Unity	Used for designing and building the game's environment and mechanics.
Visual Studio Code	Used for writing and debugging C# scripts.
Canva	Used to develop the storyboard and asset for the game.

3.3.4 User Requirements

3.3.4.1 Method of Data Collection

To collect user requirements and insights for the development of Ocean Explorer, a quantitative online survey was conducted. The survey aimed to explore the preferences, expectations, and awareness levels of potential players regarding educational games and marine life content. Additionally, it helped to structure the game flow. The questionnaire-based survey was distributed online via Google Forms. The survey consisted of five sections:

demographic information, gaming preferences and marine life awareness, game content and learning preferences, gameplay and user experience, and suggestions and feedback.

3.3.4.2 Questionnaire Development

The questionnaire was designed to cover various key aspects of Ocean Explorer's game design and functionality. The questions were structured into sections to ensure a logical flow and comprehensive data collection. Additionally, they were written in a clear, concise and unambiguous sentences. A mix of closed-ended and open-ended questions is used to collect both quantifiable data and qualitative insights. The questions were grouped into sections for better organization:

- **Section 1: Demographics**

  To gather basic information about the respondents.

- **Section 2: Gaming Preferences and Marine Life Awareness**

  To understand general gaming habits and existing knowledge of marine life.

- **Section 3: Game Content and Learning Preferences**

  To identifies specific preferences for in-game content and learning approaches.

- **Section 4: Gameplay and User Experience**

  To collect feedback on desired game mechanics, challenge types, and interface elements.

- **Section 5: Suggestions and Feedback**

  To allow for open-ended suggestions and direct feedback from respondents.

3.3.4.3 Survey Results

While the survey encompassed various aspects, the results presented here were specifically chosen for their direct relevance to shaping the core structure, game flow, and key features of the Ocean Explorer game. These findings offered valuable insights into the expectations of the target audience, guiding the design and development processes.

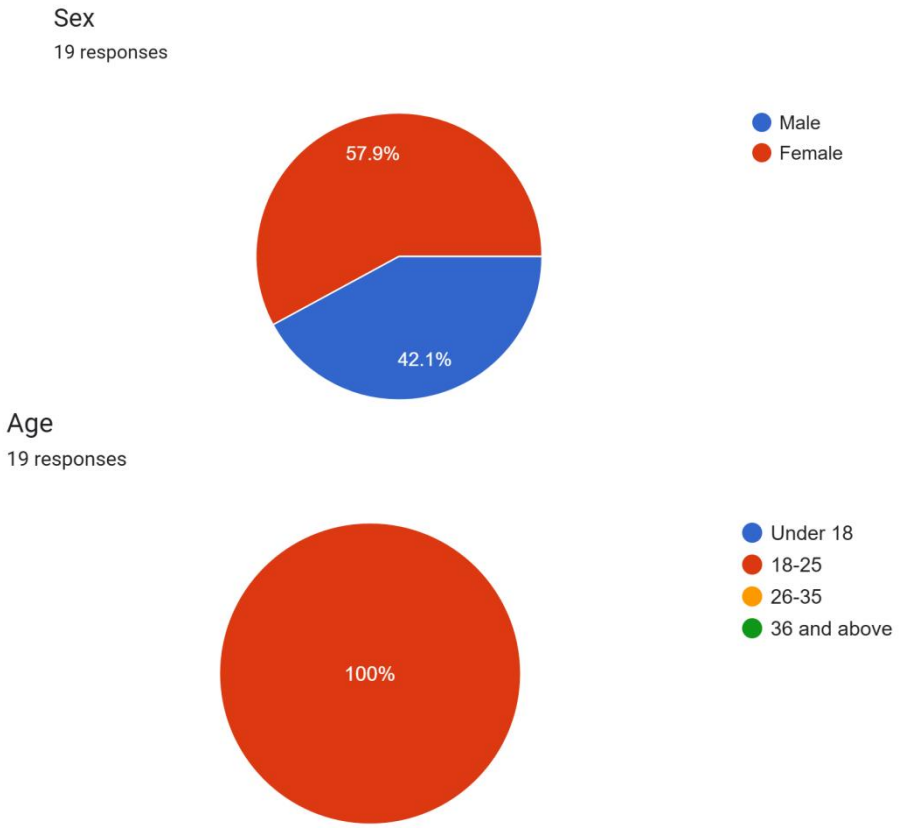

Figure 3.1: Respondents' Sex and Age Group

Based on Figure 3.1, a total of 19 respondents participated in the survey. 57.9% of the respondents were female while 42.1% of them were male. All of the respondents were age 18-25, which aligned with target user demographic.

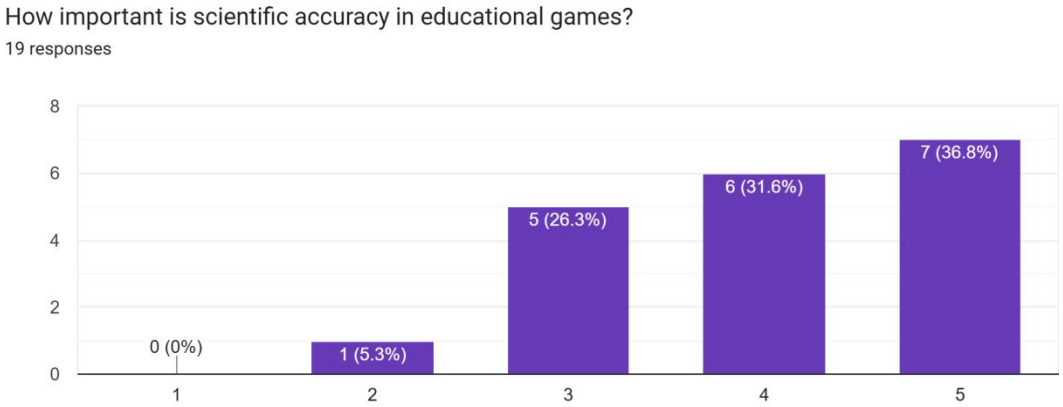

Figure 3.2: Importance of Scientific Accuracy

As shown in Figure 3.2, 36.8% felt accuracy was very important in an educational game and 31.6% considered it important. 26.3% rated accuracy as moderately important, while 5.3% reported low important.

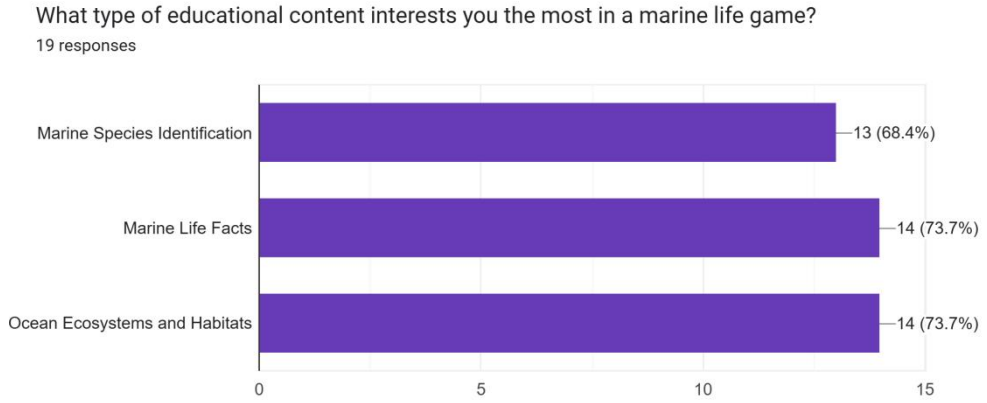

Figure 3.3: Interest in Educational Content

Figure 3.3 showed respondents' interests in specific educational content. A high percentage of 73.7% expressed interest in both marine life facts and ocean ecosystems and habitats. Additionally, 68.4% showed interest in marine species identification.

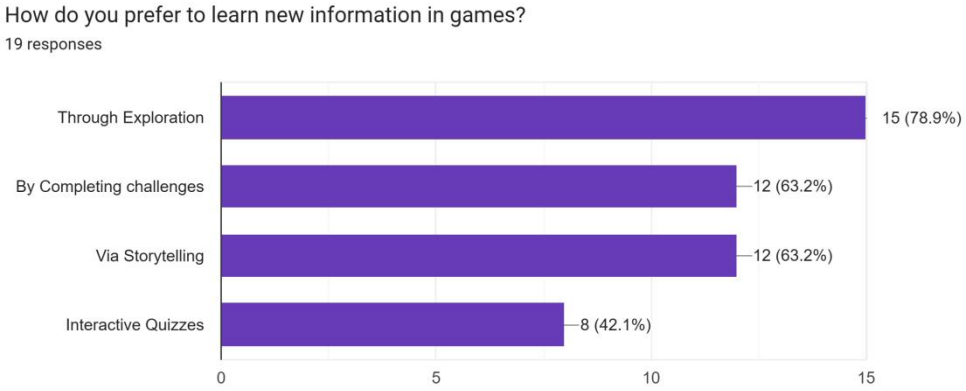

Figure 3.4: Preferred Learning Method in Games

From Figure 3.4, majority (78.9%) preferred learning through exploration. Furthermore, 63.2% preferred learning by both completing challenges and via storytelling while 42.1% expressed a preference for interactive quizzes.

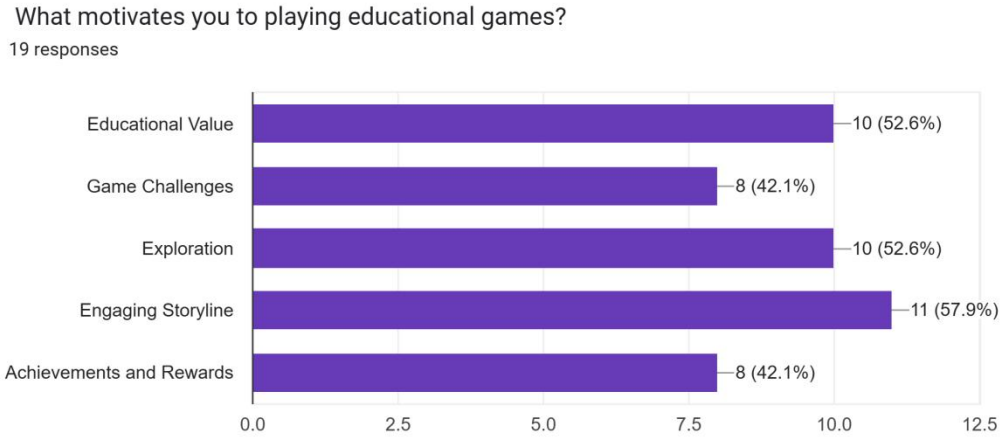

Figure 3.5: Motivates to Play Educational Games

As shown in Figure 3.5, there were several factors that motivated respondents to play educational games. A significant 57.9% stated that an engaging storyline was a key motivator. Both exploration and educational value motivated 52.6% of respondents. Additionally, 42.1% were motivated by both game challenges and achievements and rewards.

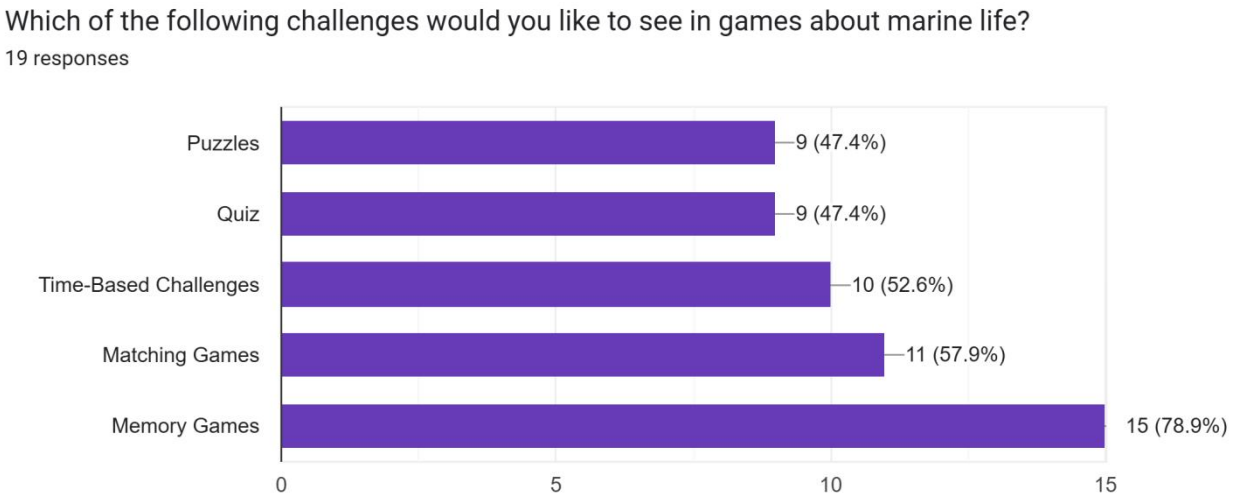

Figure 3.6: Preferred Challenges in Marine Themed Games

Figure 3.6 showed respondents' preferences for challenge types. The majority (78.9%) preferred memory games, followed by 57.9% for matching games, and 52.6% for time-based challenges. Both puzzles and quizzes were preferred by 47.4% of respondents.

3.3.4.4 Discussion of Survey Results

The survey results provided a valuable insights for the design and development of Ocean Explorer. The demographic data confirmed that the project's focus on a mobile educational game aligned well with the preferences of the respondents aged 18-25.

Scientific accuracy was highly valued by the majority, which indicated the importance of including reliable marine life facts and content details from credible sources. Additionally, most respondents expressed interest in educational content related to marine life facts and ocean ecosystems and habitats, emphasized the directions of the educational themes and depth of information.

Exploration was the most favored learning method, which led to the inclusion of exploration-based gameplay where users could discover information through interaction. To support engagement and motivation, elements such as narrative framing as the storyline,

exploration based learning, added educational value, achievement systems and game challenges were prioritized, as they reflected with what users found motivated them into playing educational games.

Lastly, respondents showed a strong interest in varied game challenges indicated that Ocean Explorer should not be belimited to a single challenges. Incorporating memory games, matching games, time-based challenges, puzzles, and quizzes would provide variety to maintain player engagement over time.

3.3.5 Use Case Analysis

Use Cases provided a systematic way to model the functional requirements of the system from the user's perspective. They described how users interacted with the system to achieve specific goals. This section included a Use Case Diagram to visually represent the main functionalities and actors and Use Case Descriptions that detailed the steps involved in each key interaction.

3.3.5.1 Use Case Diagram

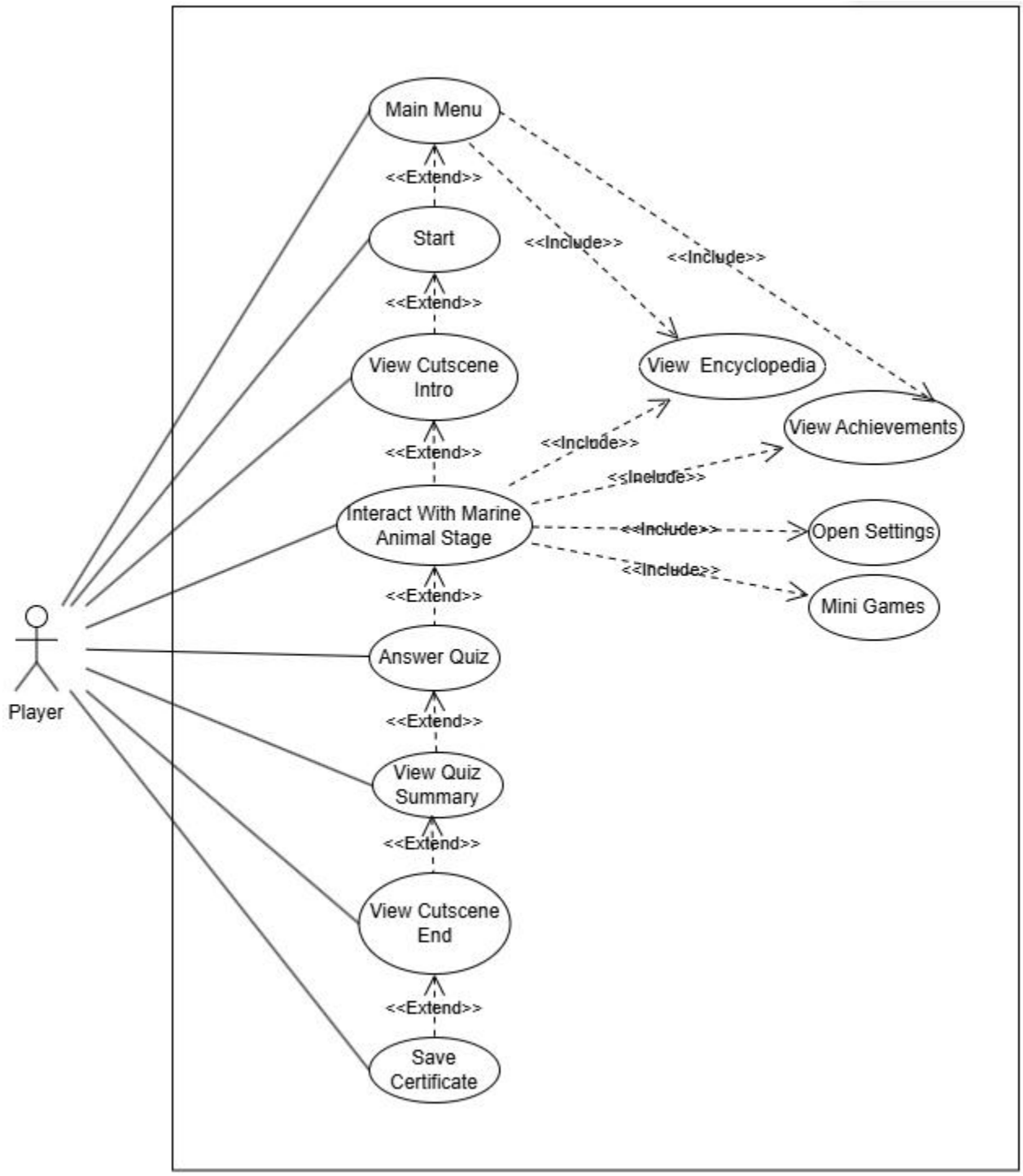

Figure 3.7: Use Case Diagram

Figure 3.7 showed the use case diagram for the Ocean Explorer game. The use case showed the interaction between the player and the system, illustrating what the player could do in the system to achieve certain goals.

3.3.5.2 Use Case Descriptions

Table 3.3: Use Case Description

Use Case Descriptions for Ocean Explorer Game **Actor:** Player
Use Case 1: Enter Main Menu **Description:** This use case described how the player to access accessed the main menu. **Pre-conditions:** The game had been launched or resumed. **Post-conditions:** The Main Menu interface was displayed to the player. **Flow of Events:** 1. The player launched the Ocean Explorer application. 2. The system displayed the Main Menu interface. **Extends**: • **Start**: Player chose to start a new game or continue. • **View Credits**: Player chose to view the game credits. • **Exit Application**: Player chose to close the application.

Use Case 2: Start

Description: This use case described the action of the player beginning a new game or continuing a previously saved game from the Main Menu.

Pre-conditions: The player was on the Main Menu.

Post-conditions: The game transitioned from the Main Menu to either the introduction cutscene (new game) or the last saved game state (continue game).

Flow of Events:

1. The player was on the Main Menu.
2. The player selected the "Start" option (or "New Game"/"Continue" if separate buttons were present).
3. The system played the introduction cutscene.

Extends:

- **View Cutscene Intro**: This use case was extended when a new game was started.

Use Case 3: View Cutscene Intro

Description: This use case described how the introduction story cutscene was shown before gameplay.

Pre-conditions: The player had started a new game.

Post-conditions: The introduction cutscene played, and then the game transitioned to "Interacted with Marine Life"

Flow of Events:

1. The system displayed the introductory cutscene.
2. The player watched the cutscene.
3. The system transitioned to the "Interact with Marine Life Stage" upon completion of the cutscene.

Extends:

- **Interacted with Marine Life Stage**: This use case was extended after the intro cutscene completed.

Use Case 4: Interact with Marine Life Stage

Description: This use case described the core gameplay loop where the player navigated a marine environment and interacted with marine life to gather information and complete missions.

Pre-conditions: The game was in an active exploration stage (Stage 1, Stage 2, Stage 3).

Post-conditions: After 7 unique marine life had been interacted with, the corresponding mini game or quiz was unlocked.

Flow of Events:

1. The player navigated the marine environment using joysticks controls.
2. The player moved near a marine lifeto triggered interact button.
3. The system displayed information about the marine life through pop up panel.

4. The system updated mission progress.

Includes:

- **Open Settings**: The player could access game settings from this stage.
- **View Encyclopedia**: The player could access the encyclopedia to review collected marine life information.
- **View Achievements**: The player could view unlocked and pending achievements.
- **Play Mini Games**: The player could play mini games upon completing stage-specific objectives.

Extends:

- **Answer Quiz**: This use case was extended when all interaction stages were completed.

Use Case 5: Open Settings

Description: This use case described how the player accessed and adjusted settings during gameplay.

Pre-conditions: The player was in an active game stage.

Post-conditions: The system saved the settings or executed the selected action.

Flow of Events:

1. The player pressed the "Settings" button.
2. The system displayed the settings menu.
3. The player adjusted desired settings such as sound or music.

4. The player chose to resume the game or return to the main menu.

Use Case 6: Viewed Encyclopedia

Description: This use case described how the player accessed the in-game encyclopedia to review detailed information about marine species they had unlocked by interacted marine life.

Pre-conditions: The player was in an active game stage or had previously encountered marine life.

Post-conditions: The encyclopedia was displayed, allowing the player to browse entries.

Flow of Events:

1. The player pressed the book icon.
2. The system displayed the encyclopedia interface with available marine life entries.
3. The player navigated through the entries.
4. The player closed the encyclopedia to return to the game.

Use Case 7: View Achievements

Description: This use case described how the player accessed the list of achievements they could unlock or had already unlocked within the game.

Pre-conditions: The player was in an active game stage.

Post-conditions: The achievements interface was displayed.

Flow of Events:

1. The player pressed the achievements button.
2. The system displayed the list of achievements and their status.
3. The player viewed the achievements.
4. The player closed the achievements interface to return to the game.

Use Case 8: Played Mini Games

Description: This use case described how the player accessed and played mini games (Puzzle Slider, Memory Game) as part of the stage completion challenges.

Pre-conditions: The player had completed the interaction objectives for a specific stage.

Post-conditions: The mini-game was played, and its completion allowed progression to the next stage.

Flow of Events:

1. The system transitioned the player to appropriate mini game upon stage objective completion.
2. The player started the mini game.
3. The player completed the mini game.

Use Case 9: Answer Quiz

Description: This use case described how the player answered quizzes to assess their knowledge, after completed all exploration stages.

Pre-conditions: The player has completed all "Interacted with Marine Life Stage" missions and mini games.

Post-conditions: The player answered all questions and the quizzes summary was ready for display.

Flow of Events:

1. The player entered the quiz scene.
2. The system presented quiz questions to the player.
3. The player selected answers for each question and received immediate feedback.
4. The system validated answers and tracked the score.
5. The quiz concluded after all questions were answered.

Extends:

- **View Quiz Summary:** This use case was extended after the quiz was completed to show results.

Use Case 10: View Quiz Summary

Description: This use case described how the player viewed the summary of their quiz performance.

Pre-conditions: The "Answer Quiz" use case had been completed.

Post-conditions: The quiz summary was displayed, and the player could choose to proceed or replay.

Flow of Events:

1. The system calculated and displayed the quiz results.
2. The player reviewed their performance.
3. The player chose to continue the game or replay the quiz.

Extends:

- **View Cutscene End:** This use case was extended after the player chose to continue from the quiz summary.

Use Case 11: View Cutscene End

Description: This use case described how the ending cutscene was played to conclude the game.

Pre-conditions: The "View Quiz Summary" use cases were completed and the player chose to continue.

Post-conditions: The end cutscene played, and the game proceeded to the certificate scene.

Flow of Events:

1. The system began playing the end cutscene.
2. The player watched the cutscene.
3. The system transitioned to the "Save Certificate" use case scene upon completion of the cutscene.

Extends:

- Save Certificate: This use case was extended after the end cutscene, allowing the player

to save their completion certificate.

Use Case 12: Save Certificate

Description: This use case described how the player could saved the digital certificate of completion to their device.

Pre-conditions: The "View Cutscene End" use case had completed.

Post-conditions: The player chose to saved the certificate image to their device or the player chose to return to the Main Menu.

Flow of Events:

1. The system displayed the certificate of completion.
2. The player pressed the button to save the certificate.
3. The system saved the image to the device's gallery.
4. The player pressed the return button to returned to the Main Menu.

3.4 Design

3.4.1 Flowchart

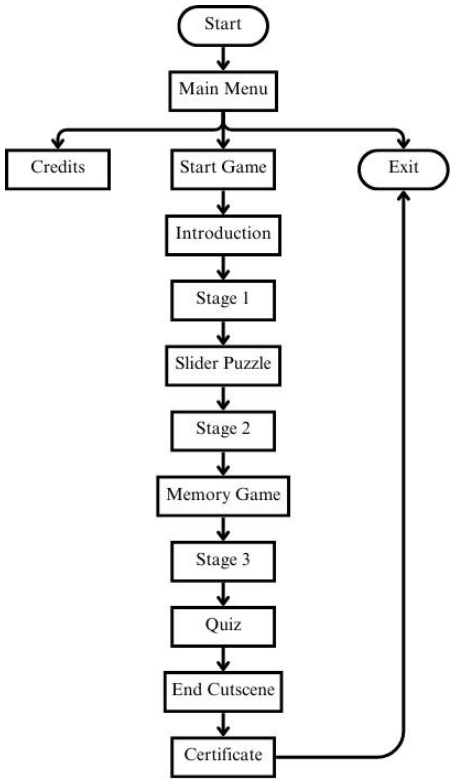

Figure 3.7: Flowchart

The flowchart in Figure 3.7 was used to show the gameplay flow of the Ocean Explorer game. Players began at the main menu, where they could select to start the game, view credits, or exit. Starting the game led players through an introduction scene and then into the coral reef environment. Each stage presented different missions and challenges, with interactive elements like tapping on marine life to learn about them and completing puzzles or quizzes. Players had to complete each challenge to advance to the next stage. Once the final stage was completed, players were presented with an end cutscene and a certificate of completion, signifying the end of the game. Players then had the option to return to the main menu.

3.4.2 Storyboard

The storyboard sketches served as a critical component in visualizing the game's narrative flow, interactions, and key gameplay moments for Ocean Explorer. It was created using Canva, a graphic design platform that provided a user-friendly interface and a variety of templates and assets to facilitate the design process. All visual assets used in the storyboard were sourced from Canva's extensive library.

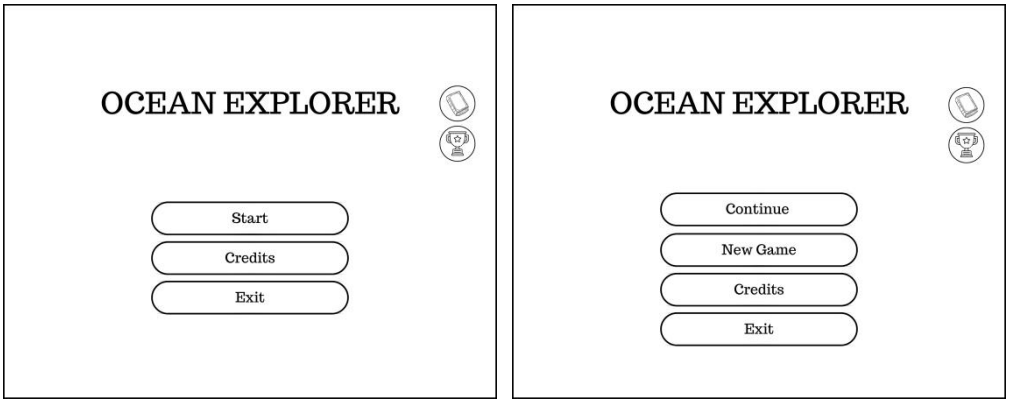

Figure 3.8: Main Menu

Players began at the main menu as shown in Figure 3.8, where they could choose to start the game, view credits, or exit. If a player wanted to pause or launch the application again after exiting, the "Start" button was replaced by "Continue" and "New Game" buttons. If "Continue" was selected, the game returned to the last scene checkpoint, while selecting "New Game" refreshed the main menu to have a "Start" button to play a new game. Upon selecting "Start", they proceeded to the introduction scene.

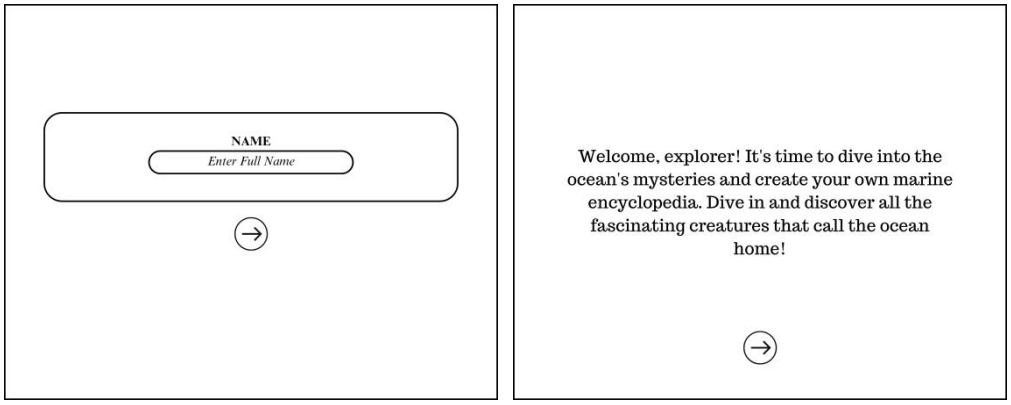

Figure 3.9: Introduction Scene

In this introduction scene as shown in Figure 3.9, the player had to enter their name to be used in the certificate of completion. Upon entering their name, a text appeared that introduced them to what they would do. A "Next" button then appeared to bring them to the Exploration Scene.

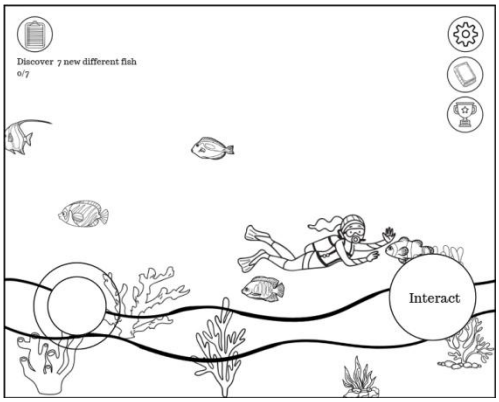

Figure 3.10: Exploration Scene

Players had to complete mission objectives before advancing to the next stage. Each stage, as shown in Figure 3.10, featured a consistent environment but introduced different marine life and games. Players moved in the environment using a joystick. Upon nearing a marine life , an interact button appeared, allowing interaction with the creatures.

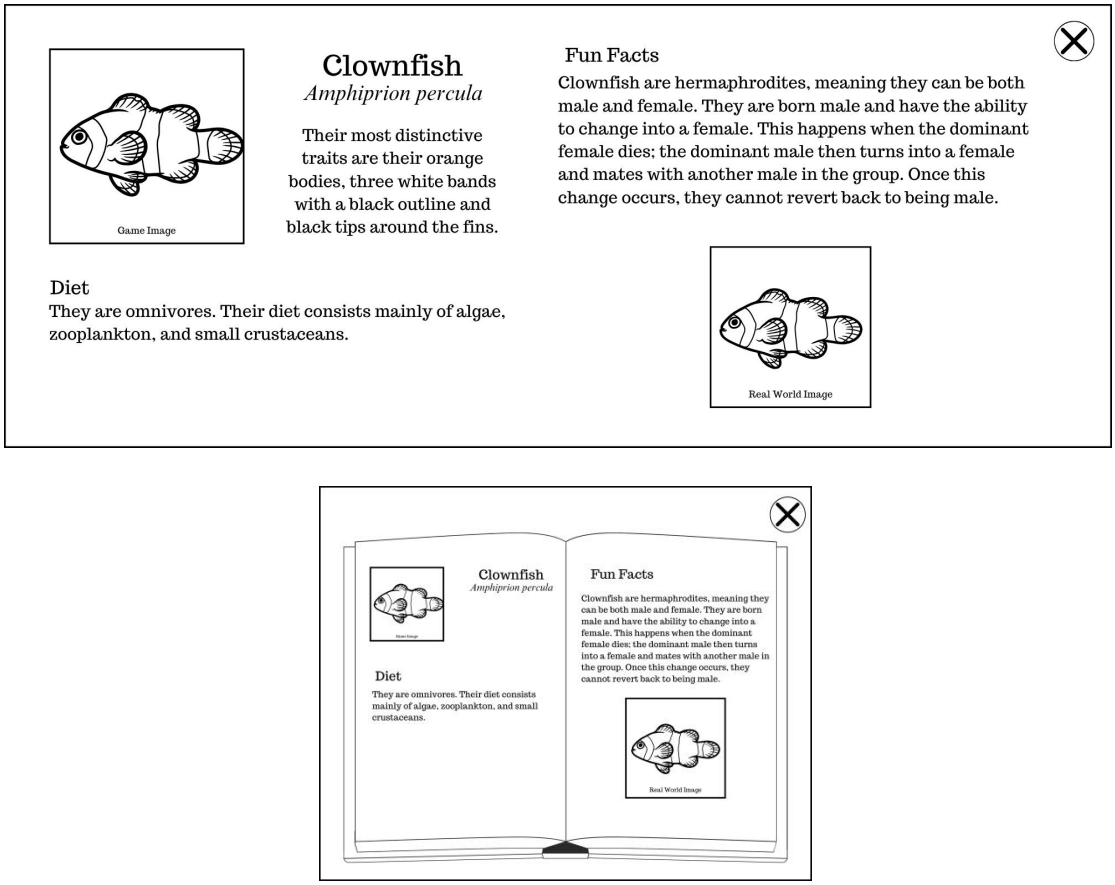

Figure 3.1: Marine Information Pop-Up and Encyclopedia

As feedback from interacting with marine life, a pop-up appeared, as shown in Figure 3.1, to provide detailed information about marine species, including their common name, scientific name, physical features, dietary habits, fun facts, and real-world images. This information was stored in the encyclopedia for future reference upon exiting the pop-up.

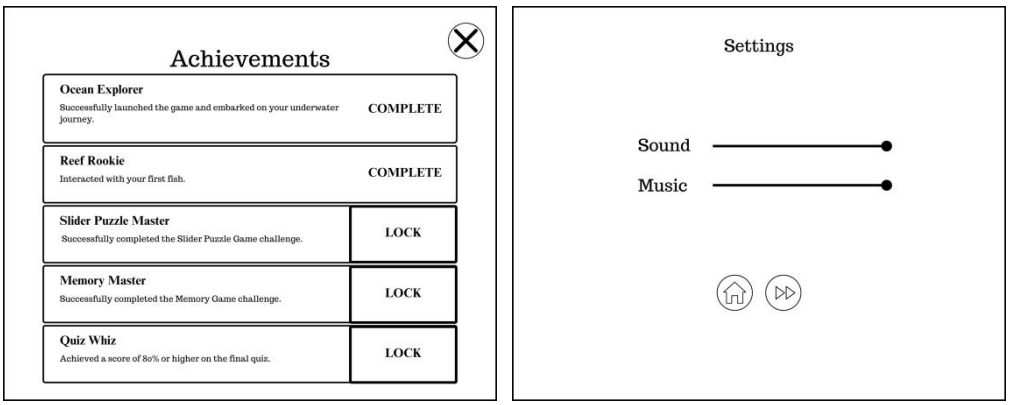

Figure 3.12: Achivements and Settings

Based on Figure 3.12, the achievements section, players could view unlocked and locked achievements. The settings menu allowed players to turn on and off sound and music, return to the main menu, or resume the game.

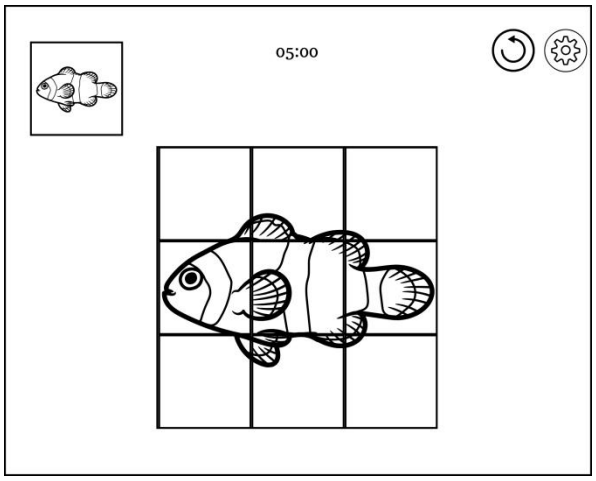

Figure 3.13: Stage 1 Challenges (Slider Puzzle)

After completing the first stage mission, players encountered a slider puzzle challenge as shown in Figure 3.13. They had to rearrange tiles to form a complete image of a marine scene to progress to the next stage. A timer helped players to see how long it took for them to complete the puzzle. A reset button allowed players to change the puzzle image and reset it.

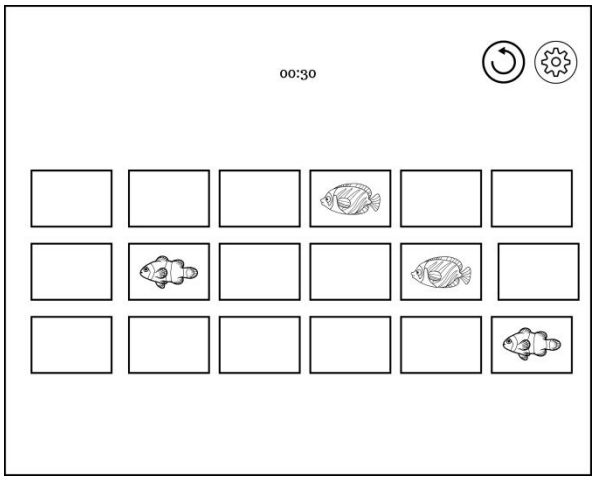

Figure 3.14: Stage 2 Challenges (Memory Puzzle)

In the subsequent stage, missions were refreshed. Players had to complete these objectives before attempting a memory game challenge, as shown in Figure 3.14, to match pairs of marine species.

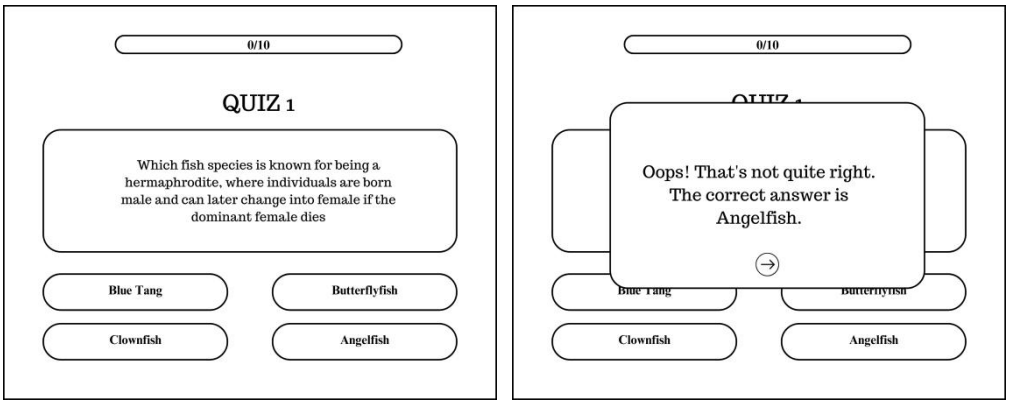

Figure 3.15: Stage 3 Challenges (Quizzes)

The final stage involved solving quizzes, as shown in Figure 3.15, with a progress counter indicating the remaining number of questions. After selecting an answer, players received immediate feedback on whether their choice was correct or incorrect.

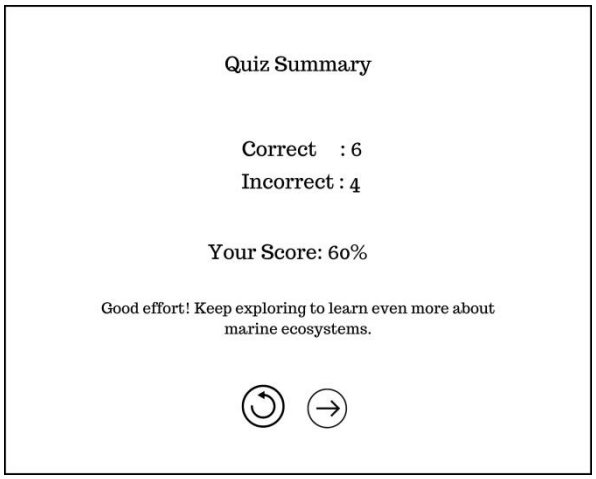

Figure 3.16: Quiz Summary

At the end of the quiz, a summary, as shown in Figure 3.16, displayed the number of correct and incorrect answers, alongside the percentage score. Players could choose to replay the quiz or continue with the game.

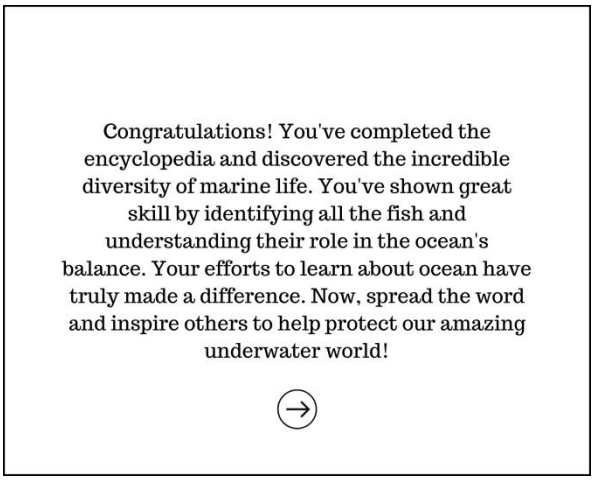

Figure 3.17: End Cutscene

After the quiz session, players were presented with an end cutscene, as shown in Figure 3.17, congratulating them on their success.

Figure 3.18: Certificate of Completion

Finally, as shown in Figure 3.18, a screen displayed a certificate of completion containing the player's name, score, and a congratulatory message. Players could save the certificate to their devices and return to the main menu, which then included an option to restart the game.

3.5 Test Case Design

This section outlined the test cases developed to evaluate the functional, non-functional requirements, and educational effectiveness of the Ocean Explorer game. These test cases were used during the testing phase to validate the usability, functionality, and effectiveness of the game.

3.5.1 Functional Test Cases

Table 3.4: Functional Test Cases

Requirement	Test Scenario	Expected Output
Launch and Navigate Menu	Player launches the game and views the Main Menu	Main Menu appears with Start, Credits, and Exit options
Start New Game	Player selects "New Game" from the Main Menu	Introduction scene appears
Continue Previous Game	Player selects "Continue" button	Game loads from the last checkpoint
Interact with Marine Life	Player moves near a marine life and click interact	Pop-up appear to display marine information
Access Encyclopedia	Player views collected marine info when click boon icon	Encyclopedia appears with unlocked marine life information
Play Puzzle Game	Player completes slider puzzle after Stage 1	Transition to Stage 2
Play Memory Game	Player completes memory game after Stage 2	Transition to Stage 3
Answer Quiz	Player completes quiz after Stage 3 and answer quiz questions	Able to answer all 10 quiz questions
View Quiz Summary	Player finishes quiz and game transitioned to view quiz summary	View score and performance summary
Save Certificate	Player able to saves certificate after completing game	Certificate saved to device

3.5.2 Non-Functional Test Cases

Table 3.4: Non-Functional Test Cases

Requirement	Test Scenario	Expected Output
Usability	Player evaluates how easy it is to navigate the menus without prior instruction	Player rates 4 or higher, indicates that the interface was intuitive
Performance	Player tests if the game lags or crashes after playing more than 10 minutes	Player reports no or crashes or lag during gameplay
Responsiveness	Player evaluates the speed of game response during interactions	Player rates 4 or higher, indicating smooth response time
Compatibility	Game runs on multiple Android devices	Game runs properly without UI or control issues
User Satisfaction	Player gives overall feedback after gameplay.	Players rates 4 or above for best experience

3.5.2 Educational Effectiveness

Table 3.6: Educational Effectiveness Test Cases

Requirement	Test Scenario	Expected Output
Knowledge Acquisition	Player completes the in-game quiz and their score reflects knowledge gained	Player's final quiz score was 60% or higher, to indicates high understanding
Information Retention	After playing the game, player can recall key facts about at least 3 different marine species (diet, characteristics, fun facts) without re-accessing the Encyclopedia	Player successfully identifies 3 species and accurately recalls at least one specific detail about each from memory
Engagement in Learning (Clarity/Interest)	Player reported how clear and interesting the information provided about marine life was (e.g., diets, fun facts) on a scale of 1 to 5.	Player rated 4 or higher for clarity and interest.
Engagement in Learning (Ease of Understanding)	Player reported how easy to understand the educational information presented in the game was on a scale of 1 to 5.	Player rated 4 or higher for ease of understanding.
Impact on Awareness	Player expresses increased awareness or interest towards marine life after playing the game	Player responds with "Yes" and provides a reason
Feedback	Player demonstrates improved understanding of incorrect answers from the quiz, indicating the feedback mechanism's effectiveness.	Player confirms the feedback was helpful

CHAPTER 4: IMPLEMENTATION

4.1 Introduction

This chapter presents the development and implementation process of the proposed 2D mobile game, Ocean Explorer. The game was implemented according to the requirements and design outlined in Chapter 3. The implementation involved setting up the development environment, configuring necessary software tools, and developing each game scene to fulfill the project objectives.

4.2 Software Installation and Configuration

This section outlines the software tools and configurations used during development, which played an important role in building, designing, and deploying the game on Android devices.

4.2.1 Unity 6

Unity 6 was chosen as the game engine. The game was built using the latest recommended Unity Editor version, 6000.0.32f1, which was installed via Unity Hub. This version provided the necessary tools and features for 2D game development. Figure 4.1 shows th interface of Unity 6.

Since the game was designed to target Android smartphones, the Android Build Support module was installed and properly configured within Unity. This ensured that the game could be compiled and executed on Android devices without many compatibility issues.

To maintain project organization and facilitate development, all game scenes were arranged to follow the flowchart sequence detailed in Chapter 3. Additionally, all assets used throughout the game were systematically organized within the Assets folder. This folder was

further divided into subfolders for different asset types such as Scripts, Arts, Scenes, and Animations, allowing for better structure and clarity during development.

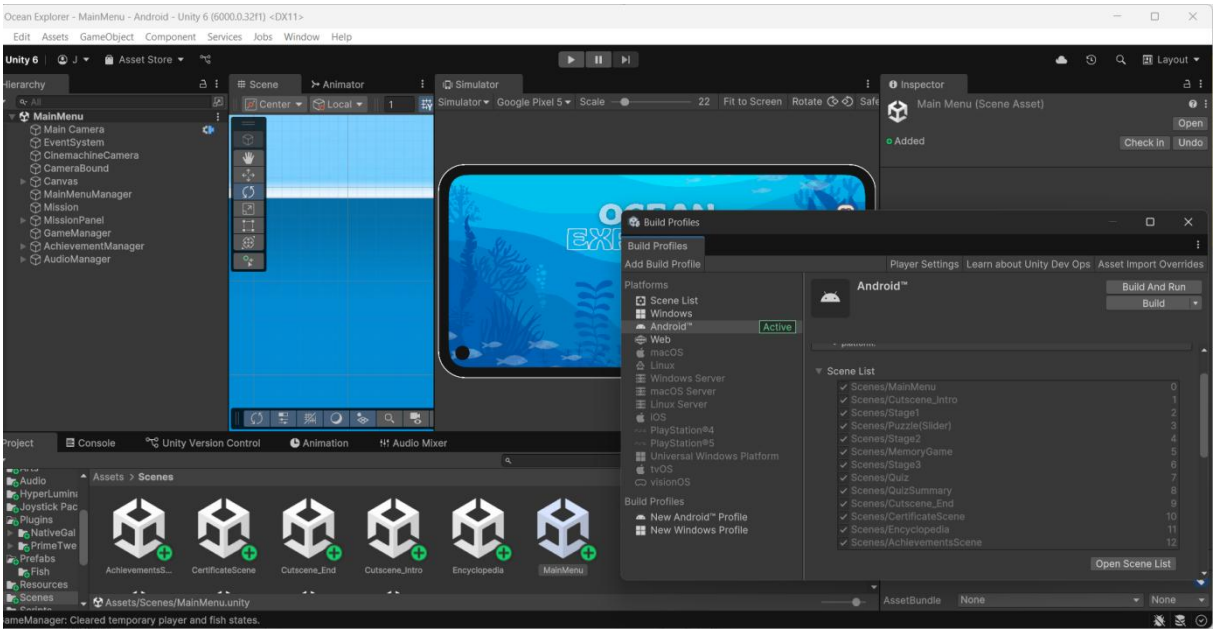

Figure 4.1: Unity 6 Interface

4.2.2 Visual Studio Code

Visual Studio Code, as shown in Figure 4.2 was chosen as the code editor due to its lightweight design, multi-language support, and robust extension library. Since the game's scripts were developed using C#, the C# extension and Unity-compatible debugging tools were downloaded and configured.

This setup provided essential features such as IntelliSense, syntax highlighting, error checking, and debugging, which significantly improved coding efficiency and helped in resolving issues during development.

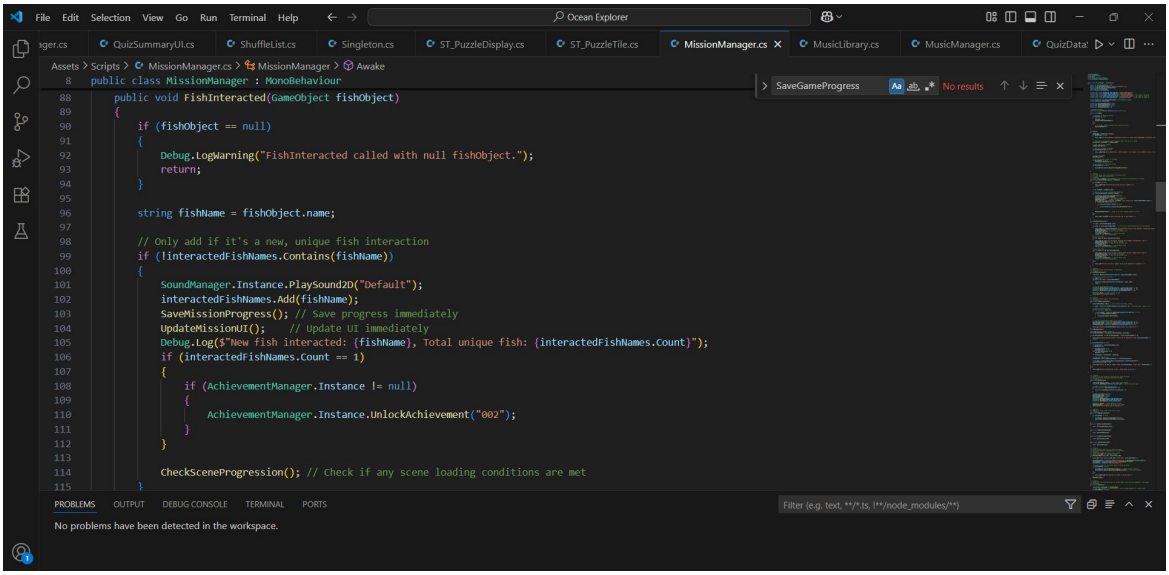

Figure 4.2: Visual Studio Code with C# Script

4.2.3 Canva

Canva, as shown in Figure 4.3, was an online graphic design tool, was utilized to design the game interface and to source various visual assets for the game. Its custom templates and extensive library of graphic elements provided a wide range of design components, ensuring a consistent and visually appealing aesthetic across all scenes in the game.

Assets designed in Canva were exported in PNG format, with transparent backgrounds when required, and were optimized for compatibility with Unity. These assets included UI elements such as buttons, panels, backgrounds, and certificate designs.

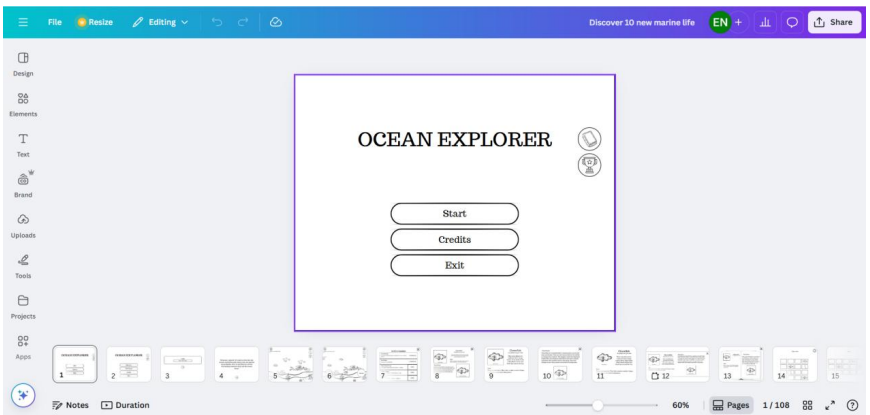

Figure 4.3: Canva Interface with Storyboard

4.2.4 Krita

Krita, as shown in Figure 4.4, was a free and open-source digital painting program, was used to edit and improve visual assets that required modification before being imported into Unity. This included tasks such as modifying button UI elements and adding color to marine life assets. Krita helped ensured the visual consistency, quality, and overall style of the game's graphical assets.

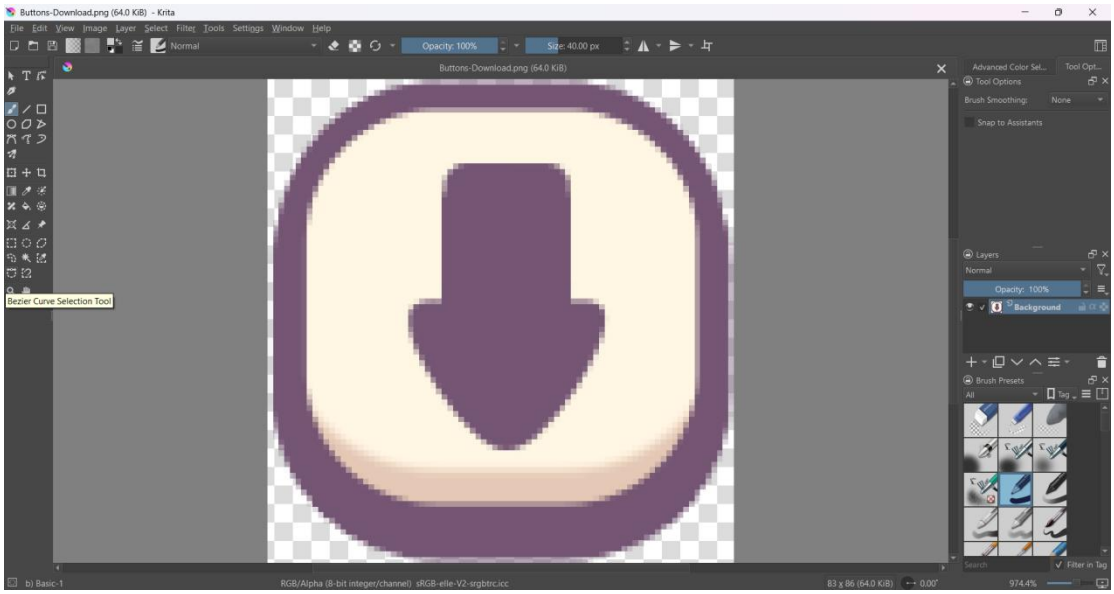

Figure 4.4: Edited Button Asset in Krita

4.3 Interface and Scene

The following sections detailed the implementation of each major scene in Ocean Explorer, focusing on the UI layout and core gameplay scripts.

4.3.1 Main Menu

The Main Menu served as the entry point of the game. Figure 4.5 shows the Main Menu UI layout which consisted of buttons for Play, Credits, and Exit for new games and after the game was reset. Continue, New Game, Credits, and Exit buttons were to resume playing in last scene checkpoint. These buttons were arranged vertically in the center of the screen using Unity's Canvas and Button components. There were also button to Achievement and Encyclopedia scene.

A background image relevant to the marine theme was used to establish the game atmosphere. Both the game title, button image and background image were sourced from Canva.

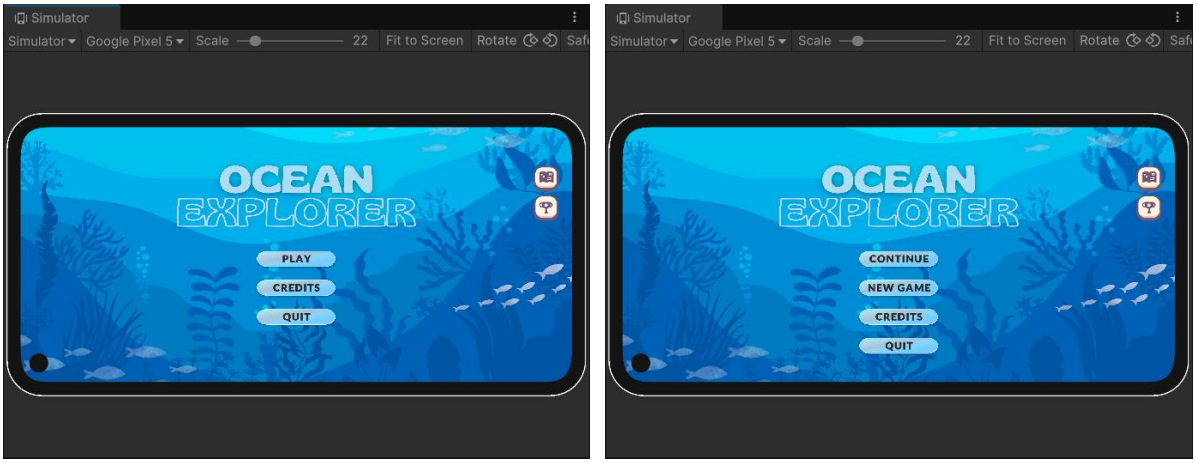

Figure 4.5: Main Menu UI Layout

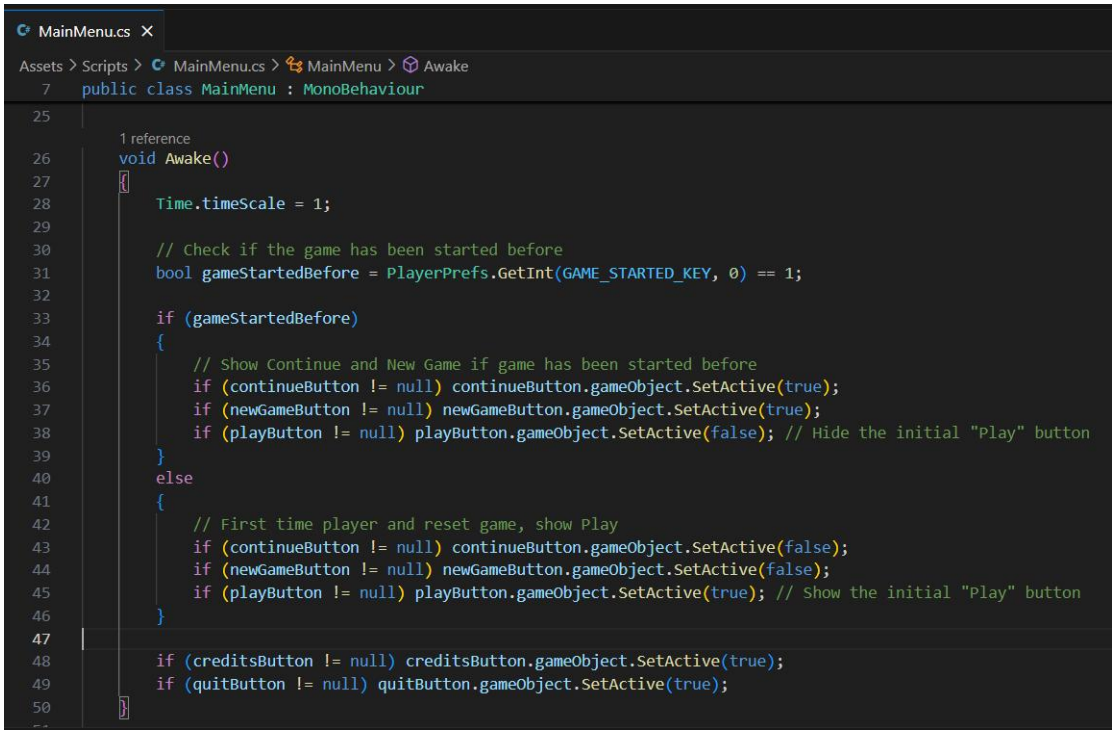

Figure 4.6: Main Menu Script (Button Toggle Logic)

Figure 4.6 shows the code that showed and hid the Play, Continue, and New Game buttons based on whether the player was new, had reset the game, or continued playing.

4.3.2 Cutscene

Figure 4.7 shows the cutscene UI of two different cutscene scenes, an introductory cutscene at the beginning of a new game and an ending cutscene upon game completion. These served to establish narrative context and provide a conclusive experience. The narrative text was displayed using TextMeshPro elements timed to make it appear typing animation.

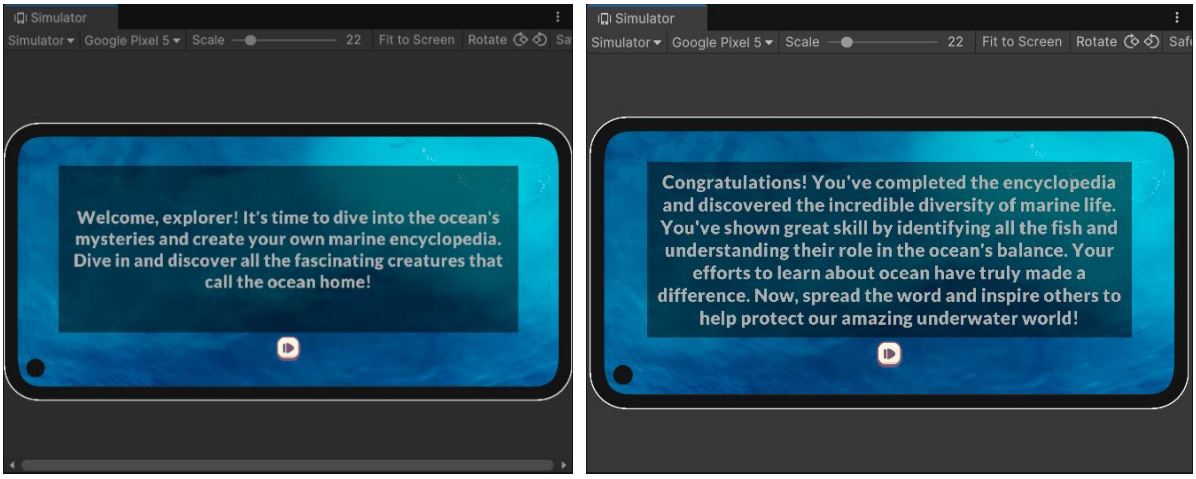

Figure 4.7: Cutscene UI (Intro and End)

CutsceneManager.cs

Assets > Scripts > CutsceneManager.cs > ...

```
7   public class CutsceneManager : MonoBehaviour
41      private void OnSubmitName()
            {
55              Debug.LogWarning("Name input is empty.");
56          }
57      }
58
        2 references
59      private void StartCutscene()
60      {
61          cutsceneText.gameObject.SetActive(true);
62          nextButton.gameObject.SetActive(false);
63          StartCoroutine(TypeSentence(message));
64      }
65
        1 reference
66      IEnumerator TypeSentence(string sentence)
67      {
68          cutsceneText.text = "";
69          foreach (char letter in sentence.ToCharArray())
70          {
71              cutsceneText.text += letter;
72              yield return new WaitForSeconds(typeSpeed);
73          }
74
75          nextButton.gameObject.SetActive(true);
76      }
77  }
```

Figure 4.8:Typing Animation Script

The code in Figure 4.8 demonstrated how the cutscene text appeared as a typing animation. Once all the text was written out, a Next button appeared to proceed to the next scene.

4.3.3 Stages

The game consisted of three stages. Figure 4.9 shows the first stage. Each stage featured a different marine life and allowed players to interact with seven unique marine life. A mission counter UI was implemented to track how many new marine life had been interacted with. Each stage included a panel showing mission progress, a joystick, an interact button, and buttons to access the Encyclopedia, Achievements, and Settings. A pop-up panel with marine life information was shown when the player clicked interact.

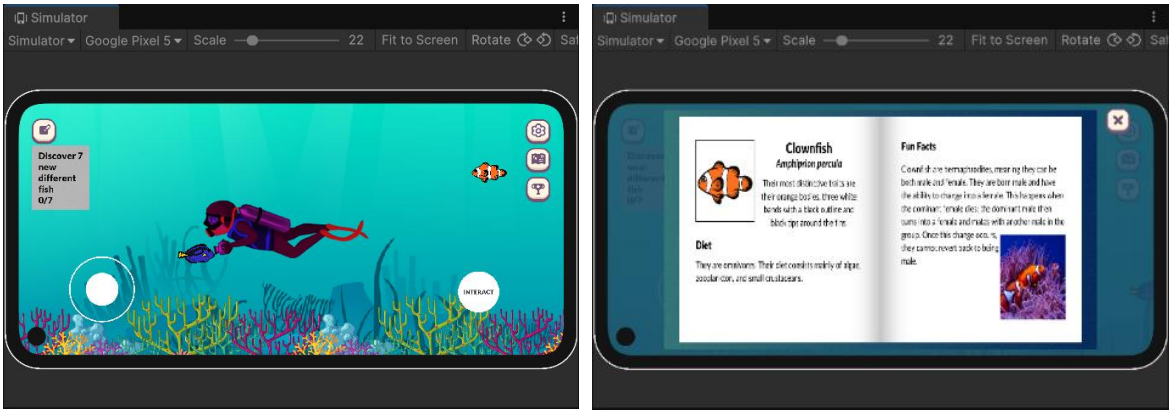

Figure 4.9: Stage Scene with Marine Life Info Panel

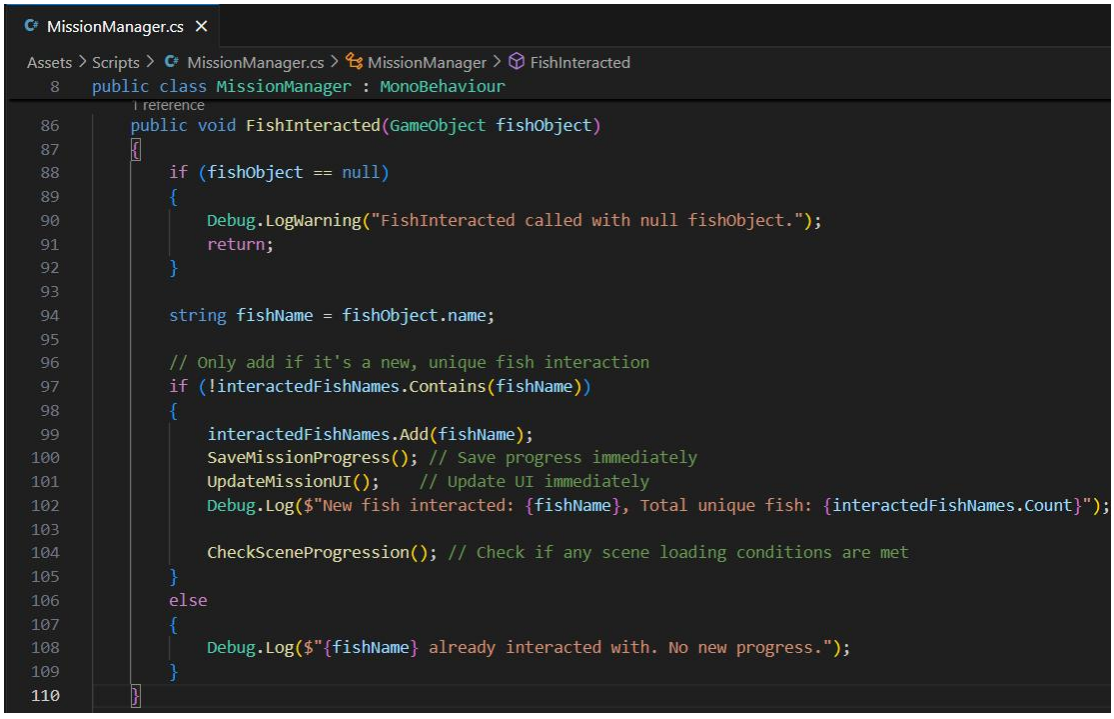

Figure 4.10: Mission Manager Scripts (Interaction Tracker)

Figure 4.10 showed the code for how mission progress increased when the player interacted with a marine life. When the mission objective was met, the system checked if the conditions were fulfilled and transitioned the player to the next scene.

4.3.4 Puzzle Slider Game

After completing Stage 1, players were directed to the Puzzle Slider scene, as shown in Figure 4.11. The puzzle consisted of a 3x3 grid with eight image tiles and one empty slot. The puzzle image was randomized using an array. A timer UI was displayed at the top to show how long players took to complete the puzzle, and both the timer and puzzle were reset when the Reset button was pressed. There was also a Settings button where players could adjust the music and sound or return to the main menu.

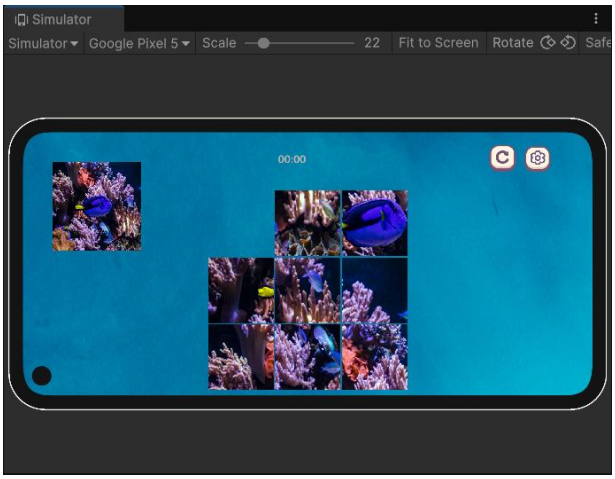

Figure 4.11: Puzzle Slider Game UI

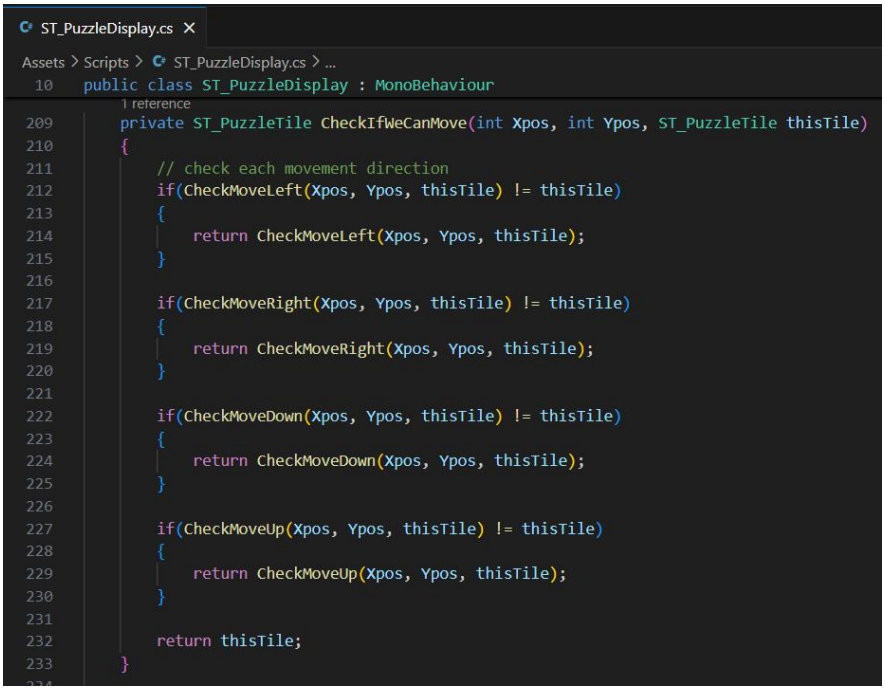

Figure 4.12: Puzzle Slider Script (Tile Movement and Validation)

Figure 4.12 showed the code that checked whether a tile could move. A tile could only move if there was an empty space at the top, bottom, left, or right of the tile piece the player wanted to move.

4.3.5 Memory Game

After completing Stage 2, players were directed to the Memory Game scene, as shown in Figure 4.13. This game consisted of matching marine life image cards. Players had to match all pairs before they could proceed to Stage 3. All images were taken from marine life previously discovered in Stage 1 and Stage 2.

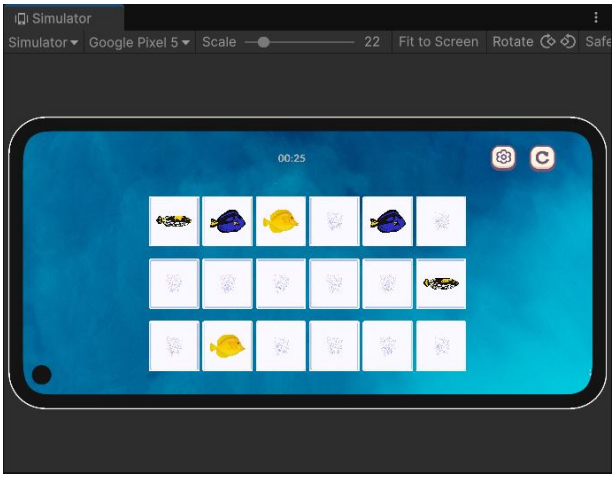

Figure 4.13: Memory Game UI

```
CardsController.cs
Assets > Scripts > CardsController.cs > CardsController > CheckMatching
10  public class CardsController : MonoBehaviour
98
        1 reference
99      IEnumerator CheckMatching(Card a, Card b)
100     {
101         yield return new WaitForSeconds(0.3f);
102         if (a.iconSprite == b.iconSprite)
103         {
104             //Match
105             matchCounts++;
106             if (matchCounts == spritePairs.Count / 2)
107             {
108                 //level complete
109                 gameEnded = true;
110                 Debug.Log("You win in " + timerText.text);
111                 PrimeTween.Sequence.Create()
112                     .Chain(PrimeTween.Tween.Scale(gridTransform, Vector3.one * 1.2f, 0.2f, ease: PrimeTween.Ease.OutBack))
113                     .Chain(PrimeTween.Tween.Scale(gridTransform, Vector3.one, 0.1f))
114                     .OnComplete(() => SceneManager.LoadScene(6)); // Load Stage 3
115
116             }
117
118         }
119         else
120         {
121             a.Hide();
122             b.Hide();
123         }
124     }
```

Figure 4.14: Card Matching Script with PrimeTween Animation

Figure 4.14 showed the code that checked whether the selected pair of cards matched. PrimeTween, a high-performance, allocation-free animation library for Unity, was used to animate the cards. Upon matching all the cards, the player was then transitioned to Stage 3.

4.3.6 Quiz

10 questions randomly selected from a predefined quiz bank. A counter helped player on keeping track how many questions left to answer. Based on scene in Figure 4.15, after each question, a result popup showed the correct answer. After answering all question, player will transition to Quiz Summary Scene.

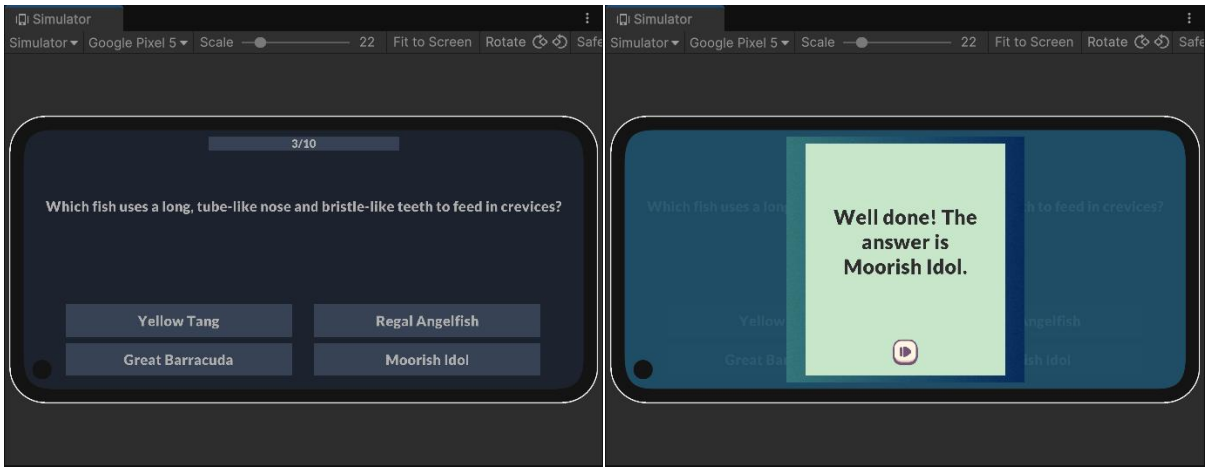

Figure 4.15: Quiz Scene And Quiz Summary Scene

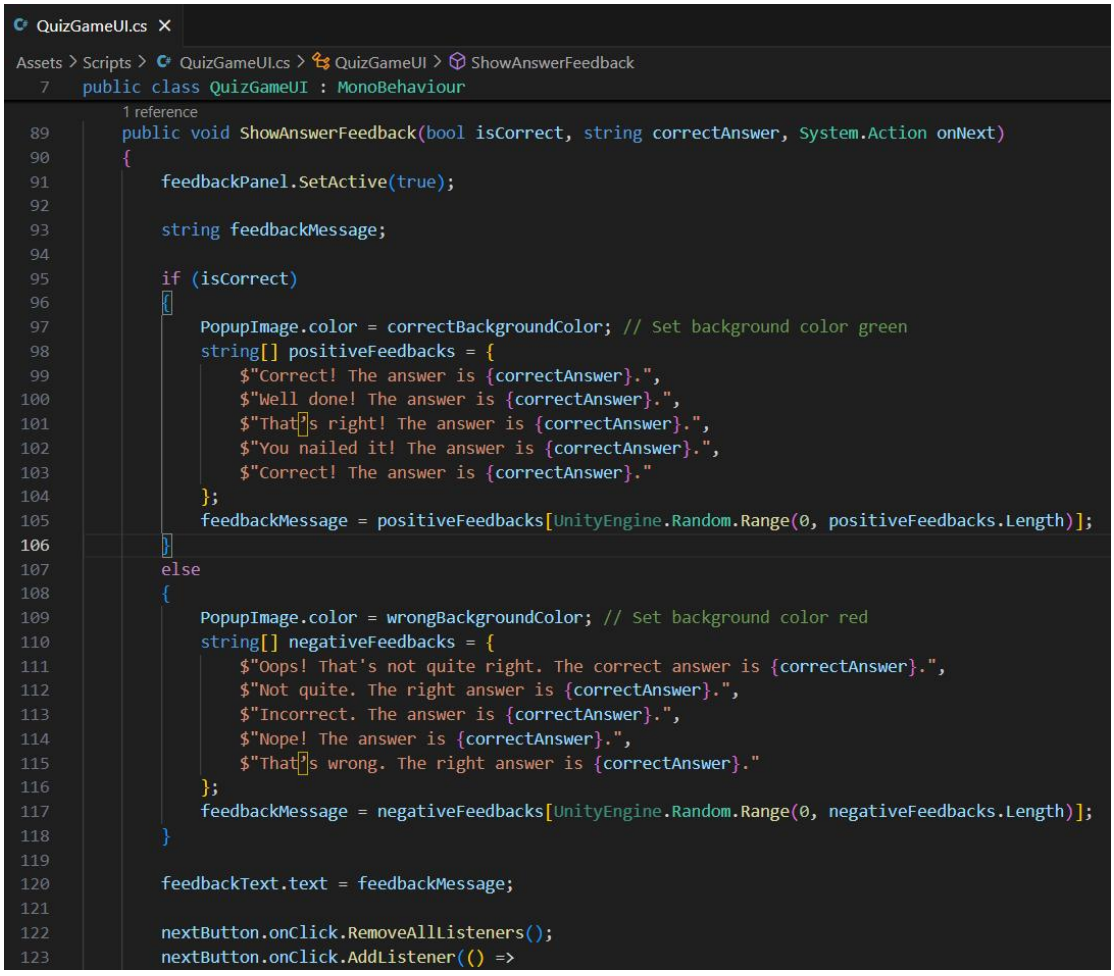

Figure 4.16: Quiz Feedback Script (Color and Answer Feedback)

Figure 4.16 showed the code that made the pop-up panel appear after the player answered a question. The pop-up panel's background color turned green for a correct answer and red for an incorrect one. The feedback also included the actual answer to the question.

4.3.7 Quiz Summary Scene

The Quiz Summary scene, as shown in Figure 4.17, showed the total number of correct and incorrect answers, the score, and the feedback text, along with Reset and Next buttons. Players could reset the quiz to try for a full score or proceed to the ending cutscene.

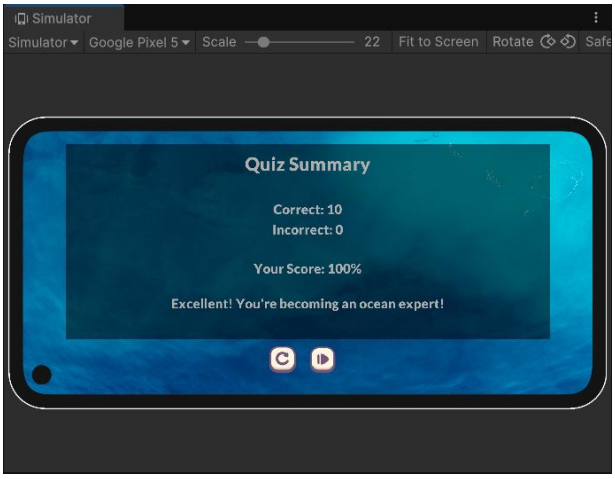

Figure 4.17: Quiz Summary UI

QuizSummaryUI.cs

Assets > Scripts > QuizSummaryUI.cs > QuizSummaryUI > Start

```
6   public class QuizSummaryUI : MonoBehaviour
        0 references
15      private void Start()
16      {
17          int correct = PlayerPrefs.GetInt("CorrectAnswers", 0);
18          int incorrect = PlayerPrefs.GetInt("IncorrectAnswers", 0);
19          int total = correct + incorrect;
20          float scorePercent = total > 0 ? (correct / (float)total) * 100f : 0f;
21
22          correctText.text = $"Correct: {correct}";
23          incorrectText.text = $"Incorrect: {incorrect}";
24          scoreText.text = $"Your Score: {scorePercent:F0}%";
25
26          if (scorePercent >= 80)
27          {
28              feedbackText.text = "Excellent! You're becoming an ocean expert!";
29              if (AchievementManager.Instance != null)
30              {
31                  AchievementManager.Instance.UnlockAchievement("005");
32              }
33              else
34              {
35                  Debug.LogError("AchievementManager.Instance is null! Cannot unlock 'Quiz Whiz' achievement.");
36              }
37          }
38          else if (scorePercent >= 50)
39          {
40              feedbackText.text = "Good effort! Keep exploring to learn even more about marine ecosystems.";
41          }
```

Figure 4.18: Quiz Summary Script

Figure 4.18 showed the code where the saved correct and incorrect answers were retrieved using the PlayerPrefs function to display them in the summary. Different scores displayed different feedback text for encouragement.

4.3.8 Certificate

Based on Figure 4.19, after the Quiz Summary scene, a certificate of completion was generated, displaying the player's name, score, and completion date. The player could save it as an image to their device.

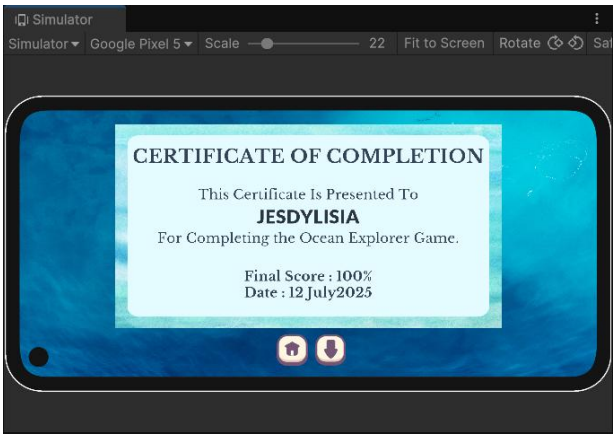

Figure 4.19: Certificate Scene UI

CertificateManager.cs

Assets > Scripts > CertificateManager.cs > CertificateManager > CaptureCertificate

```
11  public class CertificateManager : MonoBehaviour
68      IEnumerator CaptureCertificate()
157
158         try
159         {
160         #if UNITY_ANDROID || UNITY_IOS
161                     NativeGallery.SaveImageToGallery(bytes, "OceanExplorerCertificates", fileName, (success, galleryPath) =>
162                     {
163                         if (success)
164                         {
165                             Debug.Log($"Certificate saved to gallery: {galleryPath}");
166                             ShowSuccessPanelWithDelay(); // Show success panel on mobile with delay
167                         }
168                         else
169                         {
170                             Debug.LogError("Failed to save certificate to gallery. Check permissions.");
171                         }
172                     });
173             #else
174                     File.WriteAllBytes(path, bytes);
175                     Debug.Log("Certificate saved to: " + path);
176                     ShowSuccessPanelWithDelay(); // Show success panel on PC/Editor with delay
177
178             #endif
179         }
180         catch (Exception e)
181         {
182             Debug.LogError($"Failed to process certificate: {e.Message}");
183         }
```

Figure 4.20: Save Certificate Script using NativeGallery

Figure 4.20 showed the code used to save the certificate to the player's Android device. The NativeGallery plugin was used to save the image to the Gallery or Photos app on Android.

4.3.9 Encyclopedia

The encyclopedia, as shown in Figure 4.21, listed all the marine life that the player had interacted with. Each entry included a marine life game image, common name, scientific name, characteristics, diet, and a fun fact. Marine life that the player had not yet interacted with showed a blank page in the encyclopedia. Players could navigate through the entries by clicking the arrow buttons.

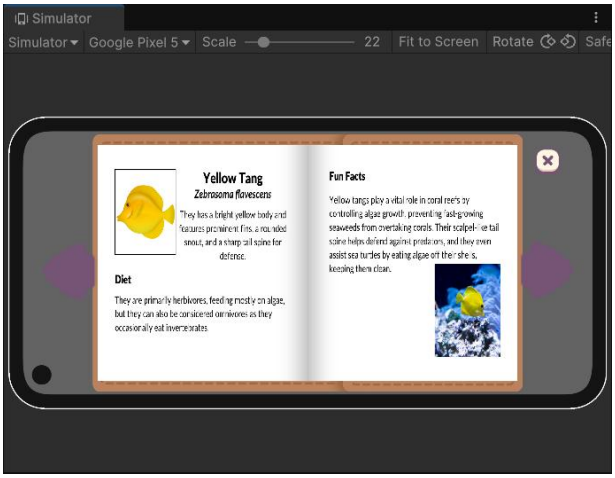

Figure 4.21: Encyclopedia UI

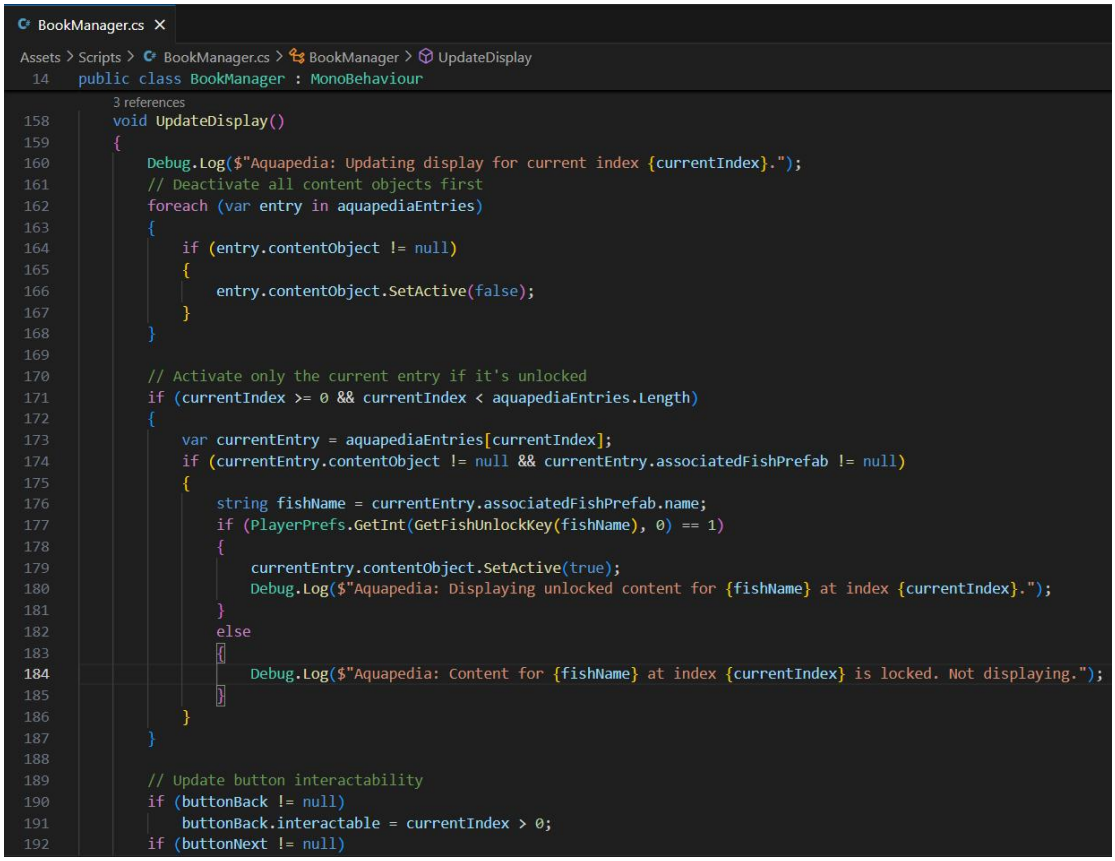

Figure 4.22: Encyclopedia Entry Script (PlayerPrefs Check)

Figure 4.22 showed the line of code that displayed information about marine life the player had interacted with. The marine life information page was only visible after the player had interacted with the marine life. The marine life name saved in PlayerPrefs was used to retrieve the key to unlocked the page associated with the marine life.

4.3.10 Achivement

The achievements system in Figure 4.23, tracked and rewarded players for completing specific in-game tasks. When an achievement was unlocked, a popup appeared. Players could then view the achievement by clicking the Achievement button.

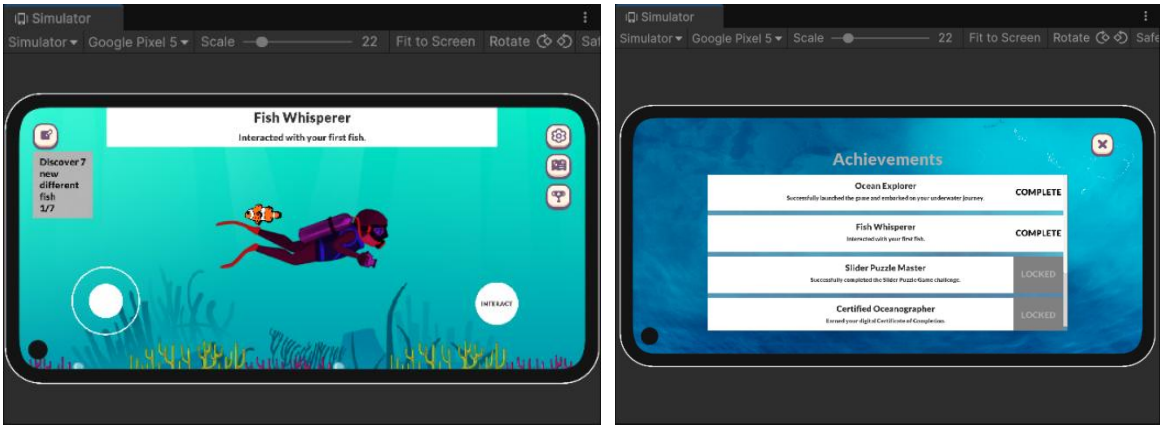

Figure 4.23: Achievement Panel and Pop-up

AchievementManager.cs

Assets > Scripts > AchievementManager.cs > AchievementManager > Awake

```
53      // to unlock an achievement based on its ID.
        7 references
54      public void UnlockAchievement(string id)
55      {
56          Achievement achievement = achievements.Find(a => a.id == id);
57          if (achievement != null && !achievement.isUnlocked)
58          {
59              achievement.isUnlocked = true;
60              PlayerPrefs.SetInt("Achievement_" + id, 1);
61              PlayerPrefs.Save(); // Save immediately when an achievement is unlocked
62
63              // Show the small temporary popup for the newly unlocked achievement
64              ShowPopup(achievement.title, achievement.description);
65
66          }
67      }
68
69      // Inside a method where the achievement list is opened or prepared to be displayed
        1 reference
70  public void NotifyAchievementListOpened()
71  {
72      OnAchievementListOpened?.Invoke(); // This line invokes the event
73  }
74
75      // Shows the small temporary popup for a newly unlocked achievement
        1 reference
76      private void ShowPopup(string title, string description)
77      {
78          if (popupPanel != null)
```

Figure 4.24: Achievement Unlock Script (ID-Based Trigger)

Figure 4.24 illustrated how an achievement was unlocked when the player fulfilled its specific requirements which were identified by ID. The achievement ID and its unlocked status were then saved in PlayerPrefs. Then, a pop-up appeared, displaying the achievement title and description.

4.4 Summary

This chapter documented the implementation process of Ocean Explorer, including software setup and the development of core game scenes. The game incorporated interactive exploration, educational content, and gamification elements such as quizzes, puzzles, and achievements. These features aligned with the project's objectives and provided a foundation for the testing and evaluation activities presented in Chapter 5.

CHAPTER 5: TESTING

5.1 Introduction

This chapter was about the testing methodology and evaluation results for Ocean Explorer. The testing phase was crucial to verify the game's functionality, performance, usability, and, specifically, its learning effectiveness, ensuring it met the objectives outlined in Chapter 1. User testing was conducted with 15 participants, who evaluated the game on their personal Android devices and provided feedback via Google Forms. The key findings were summarized in this chapter. For complete survey responses, including detailed graphs and charts, refer to Appendix A.

5.2 Functional Testing

Functional testing of Ocean Explorer focused on verifying that all features and core mechanics operated correctly as designed. This involved systematically testing each game scene and its interactive elements.

Table 5.1: Functional Testing

Requirement	Test Scenario	Expected Output	Results
Launch and Navigate Menu	Player launches the game and views the Main Menu	Main Menu appears with Start, Credits, and Exit options	Passed (15/15 testers): All testers successfully launched the game and accessed the Main Menu.
Start New Game	Player selects "New Game" from the Main Menu	Introduction scene appears	Passed (15/15 testers): The Introduction scene appeared as expected for all testers.
Continue Previous Game	Player selects "Continue" button	Game loads from the last checkpoint	Passed (15/15 testers): The game successfully loaded from the last checkpoint for all testers.
Interact with Marine Life	Player moves near a marine life and click interact	Pop-up appear to display marine information	Passed (15/15 testers): The marine information pop-up appeared as expected upon interaction for all testers.
Access Encyclopedia	Player views collected	Encyclopedia appears with	Passed (15/15 testers): The Encyclopedia appeared and

	marine info when click boon icon	unlocked marine life information	displayed unlocked marine life information correctly for all testers.
Play Puzzle Game	Player completes slider puzzle after Stage 1	Transition to Stage 2	Passed (12/15 testers): The game transitioned to Stage 2 successfully for 12 out of 15 testers. For other 3 some reported that they were unable to complete the puzzle due to its perceived high difficulty.
Play Memory Game	Player completes memory game after Stage 2	Transition to Stage 3	Passed (12/15 testers): The game transitioned to Stage 3 successfully for 12 out of 15 testers. The remaining 3 testers were likely unable to access this stage due to not having completed the preceding stages.
Answer Quiz	Player completes quiz after Stage 3 and answer quiz questions	Able to answer all 10 quiz questions	Passed (12/15 testers): 12 out of 15 testers able to access and answer all 10 quiz questions. The remaining 3 testers were likely unable to access this stage due to not having completed the preceding stages.
View Quiz Summary	Player finishes quiz and game transitioned to view quiz summary	View score and performance summary	Passed (12/15 testers): The quiz summary, including score and performance details, was viewable for 12 out of 15 testers. The remaining 3 testers were likely unable to access this stage due to not having completed the preceding stages.
Save Certificate	Player able to saves certificate after completing game	Certificate saved to device	Passed (12/15 testers): The certificate was successfully saved to the device for 12 out of 15 testers. The remaining 3 testers were likely unable to access this stage due to not having completed the preceding stages.

Based on Table 5.1, the functional testing demonstrated that Ocean Explorer largely met its core operational requirements. Initial navigation, starting new games, continuing previous progress, interacting with marine life, and accessing the Encyclopedia all functioned as expected across all 15 testers, confirming the game's foundational stability. The

implementation of gamification elements, as outlined in Objective 2, such as the puzzle game, memory game, quiz, and certificate generation, generally performed well for the testers who reached them. However, 3 testers were unable to complete the Puzzle Game, which consequently prevented them from accessing later stages and their associated features like the Memory Game, Quiz, and Certificate generation. This highlighted a potential difficulty curve issue in the Puzzle Game that impacted progression for a segment of the testers, a factor to consider for future refinements. Overall, the game's primary interactive and progression mechanics were successfully verified.

5.3 Non-Functional Testing

Non-functional testing evaluated Ocean Explorer's attributes, including its usability, performance, responsiveness, compatibility, and overall user satisfaction.

Table 5.2: Non-Functional Testing

Requirement	Test Scenario	Expected Output	Results
Usability	Player evaluates how easy it is to navigate the menus without prior instruction	Player rates 4 or higher, indicates that the interface was intuitive	Partial Pass: Out of 15 testers, 2 rated the interface as a "Neutral" (3), 4 rated it as "Easy" (4), and 9 rated it as "Very easy" (5). The majority found the interface intuitive, though a small segment desired further clarity.
Performance	Player tests if the game lags or crashes after playing more than 10 minutes	Player reports no or crashes or lag during gameplay	Partial Pass: 12 testers reported no crashes or lag. However, 1 tester experienced minor lag, and another reported overlapping labels requiring an app refresh before interaction. Additionally, 1 tester noted an issue with the settings button not functioning correctly during the puzzle game.
Responsiveness	Player evaluates the speed of game response during interactions	Player rates 4 or higher, indicating smooth response time	Passed: 8 testers rated the game's responsiveness as "Responsive" (4), and 7 rated it as "Very responsive" (5). This indicates high satisfaction with game interaction speed.

Compatibility	Game runs on multiple Android devices	Game runs properly without UI or control issues	Passed: All testers reported no issues with the game running properly, indicating consistent UI and control functionality across various Android devices.
User Satisfaction	Player gives overall feedback after gameplay.	Players rates 4 or above for best experience	Partial Pass: Out of 15 testers, 1 reported being "Dissatisfied" (2). However, 7 reported being "Satisfied" (4), and 7 reported being "Very satisfied" (5). The majority expressed positive overall satisfaction with the gameplay experience.

Based on Table 5.2, the non-functional testing generally yielded positive results for Ocean Explorer's quality attributes, contributing to the overall objective of developing an effective mobile game. The game demonstrated strong responsiveness and compatibility, running properly across a range of Android devices without significant UI or control issues, which is critical for a mobile application. While usability received mostly positive feedback, indicating an intuitive interface for most users, a small number of testers felt it could be clearer, suggesting minor areas for improvement. Performance was largely stable, with the majority experiencing no lag or crashes during extended play; however, some reports of minor lag, overlapping labels, and unresponsive buttons highlighted specific areas for optimization on certain device configurations. Overall user satisfaction was high, with the vast majority of testers expressing satisfaction or very high satisfaction, although one tester reported dissatisfaction. These findings affirm the game's robust technical foundation and generally positive user experience, setting the stage for its effectiveness in educating users, aligning with Objective 3.

5.4 Educational Effectiveness Testing

This section outlines the evaluation of Ocean Explorer's ability to foster knowledge acquisition, promote information retention, engage players in educational content, increase marine awareness, and provide helpful feedback, directly addressing Objective 3.

Table 5.3: Educational Effectiveness Testing

Requirement	Test Scenario	Expected Output	Results
Knowledge Acquisition	Player completes the in-game quiz and their score reflects knowledge gained	Player's final quiz score was 60% or higher, to indicates high understanding	Partial Pass: Scores varied widely among the 15 testers. Scores reported were 80% (5 testers), 50% (2 testers), 100% (1 tester), 53% (1 tester), 75% (1 tester), 70% (1 tester), and 30% (1 tester), and 40% (1 tester). Two testers did not complete the quiz due to an inability to progress past the first puzzle. Note: Reported scores of 53% and 75% for a 10-question quiz suggest potential miscalculation by the testers or rounding, as only whole percentages divisible by 10 are strictly possible. The raw scores (e.g., 5/10, 8/10) would be more accurate.
Information Retention	After playing the game, player can recall key facts about at least 3 different marine species (diet, characteristics, fun facts) without re-accessing the Encyclopedia	Player successfully identifies 3 species and accurately recalls at least one specific detail about each from memory	Partial Pass: Only 3 out of 15 testers successfully listed marine life along with specific facts about them. The remaining 12 testers could identify marine life names but were unable to provide any factual details from memory without revisiting the Encyclopedia.
Engagement in Learning (Clarity/Interest)	Player reported how clear and interesting the information provided about	Player rated 4 or higher for clarity and interest.	Partial Pass: Out of 15 testers, 1 rated it as "Not at all clear/interesting" (1), 4 rated it as "Neutral" (3), and 10 rated it as "Very clear/interesting" (4 or 5).

	marine life was (e.g., diets, fun facts) on a scale of 1 to 5.		The majority found the information engaging.
Engagement in Learning (Ease of Understanding)	Player reported how easy to understand the educational information presented in the game was on a scale of 1 to 5.	Player rated 4 or higher for ease of understanding.	Partial Passed: Out of 15 testers, 3 rated it as "Neutral" (3), 5 rated it as "Easy" (4), and 7 rated it as "Very Easy" (5). The vast majority found the educational content easy to comprehend.
Impact on Awareness	Player expresses increased awareness or interest towards marine life after playing the game	Player responds with "Yes" and provides a reason	Partial Pass: 8 testers reported "No" increased awareness. However, 7 testers responded "Yes" or indicated some level of increased awareness or interest, citing reasons such as learning about rarely seen marine life, discovering many kinds of marine life, or drawing connections to 'Finding Nemo' characters.
Feedback	Player demonstrates improved understanding of incorrect answers from the quiz, indicating the feedback mechanism's effectiveness.	Player confirms the feedback was helpful	Partial Pass: 11 testers confirmed the feedback was "Yes" helpful. 1 tester found it "No" helpful, and 3 testers responded "Maybe," indicating mixed views on the effectiveness of the quiz feedback for all users.

Based on Table 5.3, the educational effectiveness testing yielded mixed but promising results, directly addressing Objective 3 of evaluating the game's educational impact. While Knowledge Acquisition demonstrated varied quiz scores, indicating that not all users achieved a high level of understanding solely from gameplay, the presence of 100% and 80% scores suggests potential. The noted discrepancies in reported percentages for a 10-question quiz point to a need for clearer score communication. Information Retention showed room for improvement, as most testers could identify marine life but struggled to recall specific facts

without the Encyclopedia, suggesting that passive interaction alone may not suffice for deeper learning.

However, the Engagement in Learning aspects were generally positive with majority of testers found the educational content clear, interesting, and easy to understand, aligning with the goal of presenting information effectively. The Impact on Awareness was split, with about half of the testers reporting an increased interest in marine life, indicating that the game successfully sparked curiosity for a significant portion of its audience. Finally, the Feedback mechanism in the quiz was largely perceived as helpful, reinforcing its role in supporting the learning process. These findings highlight that Ocean Explorer successfully engaged users with its marine life content, but further refinement to instructional design and information reinforcement could enhance knowledge acquisition and retention for all players.

5.5 Summary

This chapter was about the testing and evaluation of Ocean Explorer. Functional testing confirmed the game's core mechanics and scene transitions operated largely as intended, though it highlighted a challenge with the Puzzle Game's difficulty impacting progression for some users. Non-functional testing revealed strong responsiveness and compatibility across Android devices, with overall positive usability and user satisfaction, despite minor performance issues. Finally, educational effectiveness testing, directly addressing the project's third objective, showed varied success in knowledge acquisition and information retention but demonstrated strong engagement in learning and a positive impact on marine awareness for a significant portion of testers. While the game proved effective in engaging users with marine life content, the testing results identified key areas for future improvements in educational reinforcement and game progression balance.

CHAPTER 6: CONCLUSION

6.1 Introduction

This chapter concludes the report on "Ocean Explorer: An Interactive Educational Mobile Game for Marine Life and Ecosystems Awareness". It summarizes the project's achievements, discusses the limitations encountered during its development and evaluation, and suggestions for future work.

6.2 Achievements

The project successfully met its objectives. Firstly, an interactive 2D mobile game focused on marine life and ecosystems was successfully developed, featuring multiple stages, engaging mini-games such as Puzzle Slider and Memory Game, and an informative Encyclopedia. Secondly, various gamification elements, including quizzes, puzzles, achievements, and feedback mechanisms, were effectively implemented. Functional testing confirmed the stability of core game mechanics, menu navigation, and scene transitions, with all primary interactive features operating as expected for the majority of testers. Non-functional testing revealed strong responsiveness and compatibility across a range of Android devices, contributing to a generally positive user experience and high user satisfaction. Furthermore, educational effectiveness testing demonstrated the game's ability to engage users with marine life content, and for a significant portion of testers, it successfully sparked increased awareness and interest in marine ecosystems.

6.3 Limitations

Despite the project's successes, several limitations were identified during testing and development. A notable challenge emerged in the difficulty of the Puzzle Game, which prevented three out of fifteen testers from progressing to subsequent stages, consequently

limiting their exposure to later game content like the Memory Game, Quiz, and Certificate generation. In terms of knowledge acquisition, quiz scores varied widely, and issues with the reporting of non-whole percentages suggested potential for clearer score communication within the game. Information retention also presented a limitation, as a majority of testers struggled to recall specific marine facts from memory without revisiting the Encyclopedia, indicating that the current method of information presentation might require further reinforcement for deeper learning. Minor performance observations, such as occasional visual lag on devices, overlapping labels requiring an app refresh, and an unresponsive settings button, were reported by a few testers, suggesting areas for further optimization. Finally, while most users expressed satisfaction, one tester reported dissatisfaction with the overall user experience.

6.4 Future Works

Several areas for future improvement in Ocean Explorer were identified based on the limitations and opportunities for improvement. Firstly, the Slider Puzzle Game could be replaced with a new activity that better aligns with the game's objectives or player preferences. Secondly, to enhance knowledge acquisition and information retention, future work could explore more active learning methods, such as mini-games specifically focused on recalling facts or spaced repetition of learned content. Performance optimization for various Android device specifications would also be beneficial to address occasional lag and UI rendering issues. Lastly, expanding the diversity of marine species and ecosystems covered could further enrich the educational content.

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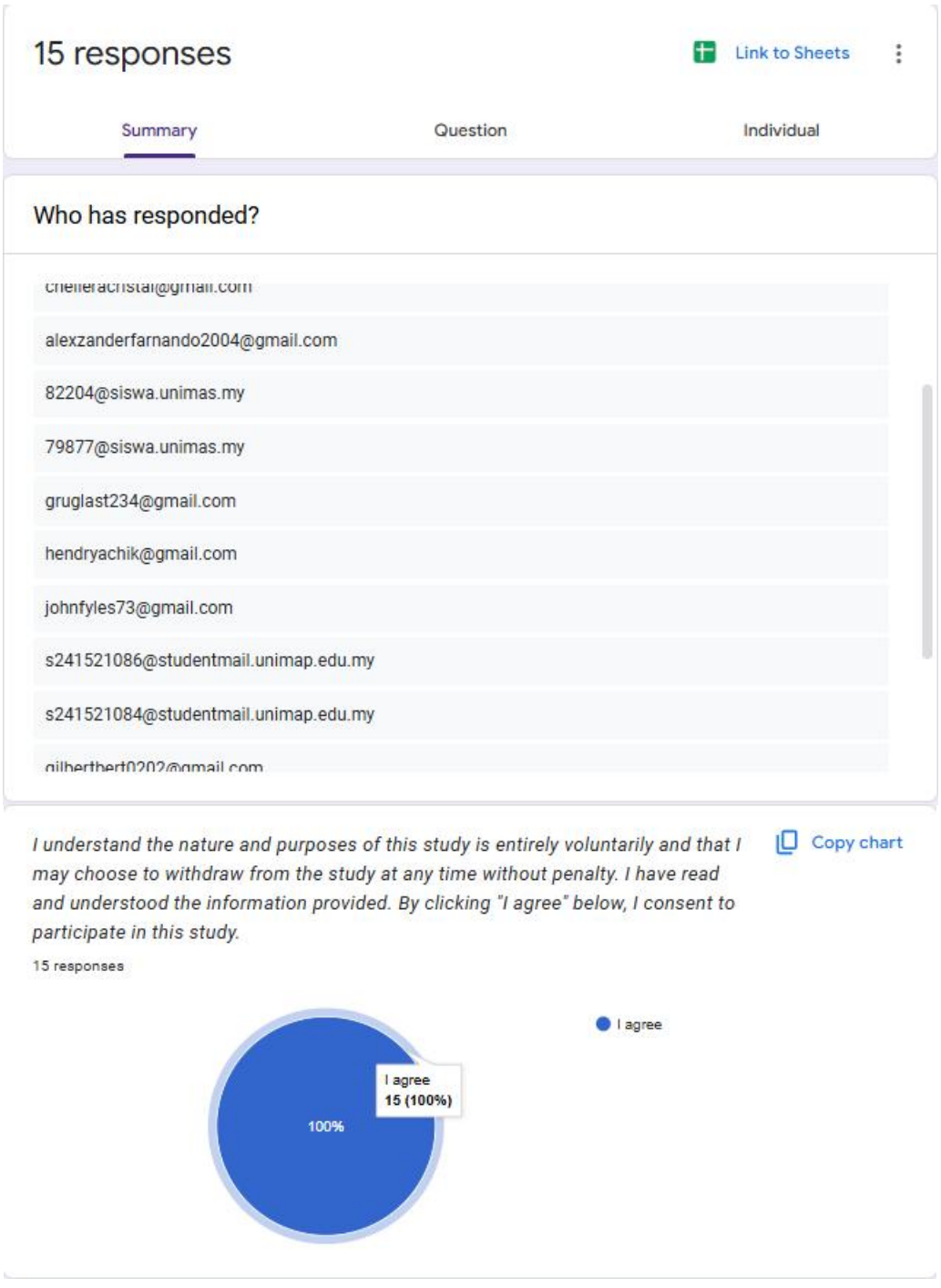
APPENDIX A

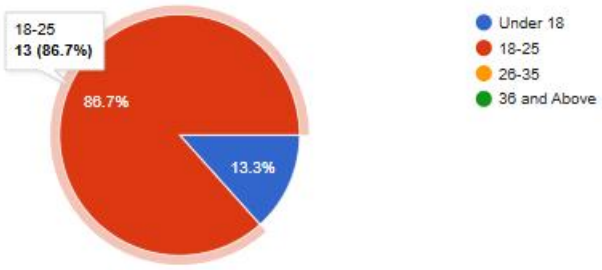

15 responses
Link to Sheets
Summary
Question
Individual
Who has responded?
alexzanderfarnando2004@gmail.com
82204@siswa.unimas.my
79877@siswa.unimas.my
gruglast234@gmail.com
hendryachik@gmail.com
johnfyles73@gmail.com
s241521086@studentmail.unimap.edu.my
s241521084@studentmail.unimap.edu.my
I understand the nature and purposes of this study is entirely voluntarily and that I may choose to withdraw from the study at any time without penalty. I have read and understood the information provided. By clicking "I agree" below, I consent to participate in this study.
Copy chart
15 responses
I agree
I agree
15 (100%)
100%

Section 1: Demographics

Age

Copy chart

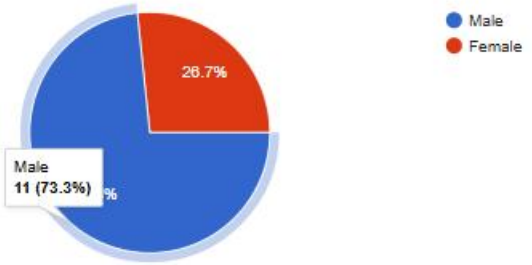
15 responses



Sex

Copy chart

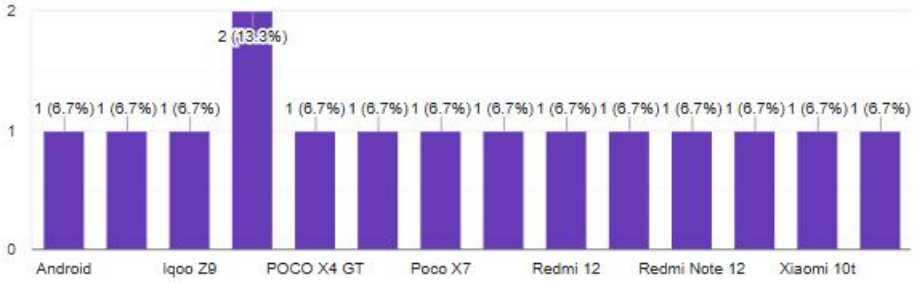
15 responses



What type of device did you use to test the game?(Ex. Redmi 13G, Xiaomi14T) (Only for Android User)

Copy chart

15 responses



Section 2: Functional Test Cases

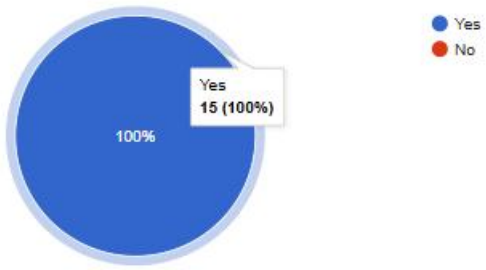
Launch and Navigate Menu

Copy chart

Did the game launch successfully and display the Main Menu with the expected options?

(Main Menu appears with Start, Credits, and Exit options)

15 responses



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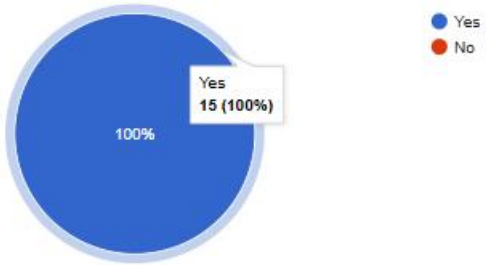
Start New Game

After selecting 'New Game' from the Main Menu, did the Introduction scene appear?

15 responses



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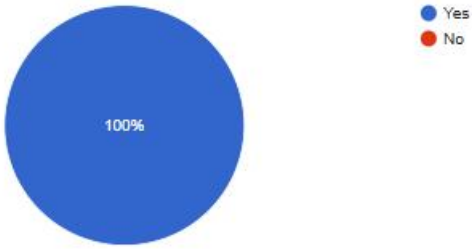
Continue Previous Game

If you had a previous game saved, when you clicked 'Continue', did the game load from your last checkpoint?

15 responses

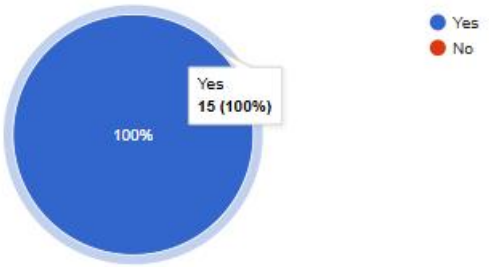


Interact with Fish

Copy chart

When you moved your player near a fish and clicked to interact, did a pop-up appear displaying marine information?

15 responses



Access Encyclopedia

Copy chart

When you clicked the book icon, did the Encyclopedia appear with information for unlocked fish?

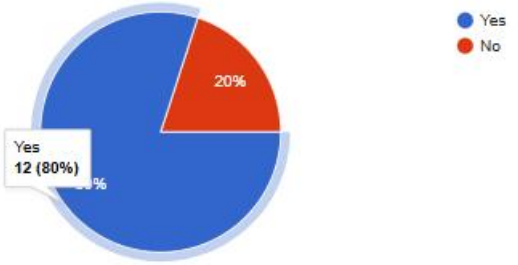
15 responses

Play Puzzle Game

Copy chart

After completing Stage 1, were you able to successfully solve the slider puzzle and transition to Stage 2?

15 responses

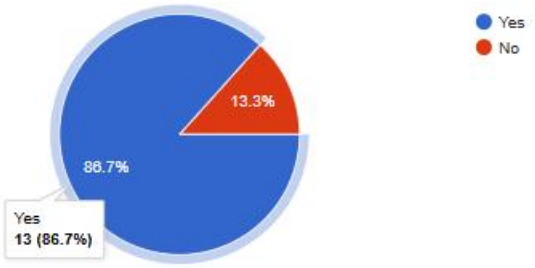


Copy chart

Play Memory Game

After completing Stage 2, were you able to successfully match the pairs in the memory game and transition to Stage 3?

15 responses

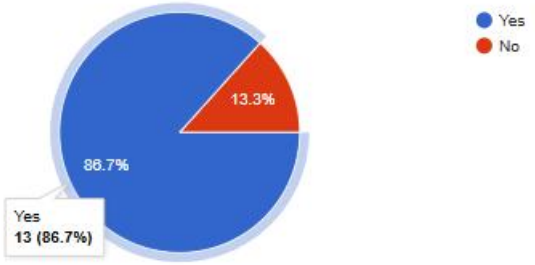


Copy chart

Answer Quiz

After completing Stage 3, were you able to answer all 10 questions in the quiz and did the quiz results summary then appear?

15 responses



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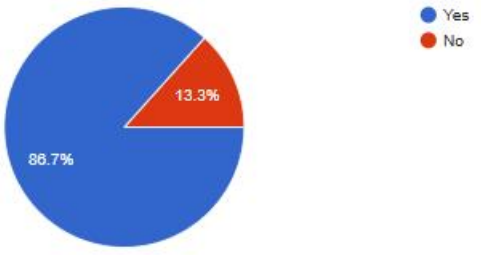
View Quiz Summary

Upon finishing the quiz, did you successfully view your score and performance summary?

15 responses



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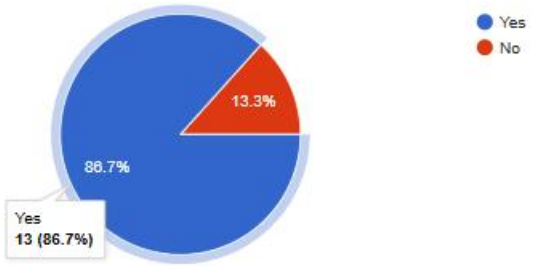
Save Certificate

After completing the game, when you clicked "Save", was the certificate saved to your device?

15 responses



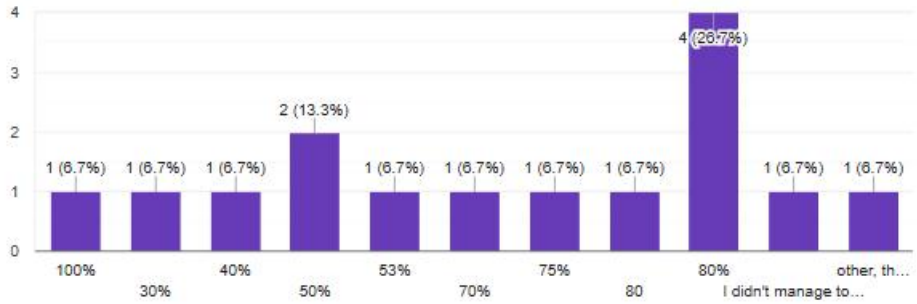
Section 3 : Educational Effectiveness Test Cases

Copy chart

Knowledge Acquisition (Quiz Score)

Please provide your final quiz score (e.g., 80%, 100%).

15 responses



Information Retention

Without re-opening the in-game Encyclopedia, please list 3 marine animals you remember from the game and one unique fact (e.g., diet, characteristic, or fun fact) about each.

(Ex. Clownfish - male can change to female when dominant female dies)

15 responses

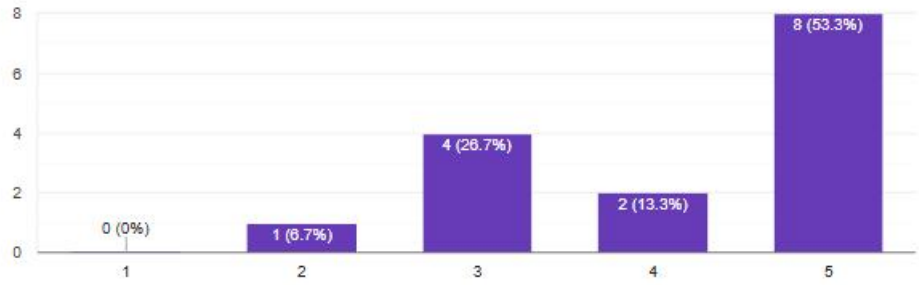
Clownfish - male can change to female when dominant female dies
Clown triggerfish - black body with large white spots. Yellow ringed mouth Nothern red snapper- drumming sound (when threatened) Royal Gramma - two-toned body (violet to yellow)
Clownfish, yellow tang, Flameagle fish
I only remember fish name, pacific blue tang, yellow tang and lionfish.
blue tang, clownfish, something idol hahah
Northen Red Snapper
Clown Trigger Fish, Banggai Cardinal Fish, Royal Gramma
Regal Anglefish, Picasso Tiggerfish, Moorish Idol

Copy chart

Engagement in Learning (Part 1)

On a scale of 1 to 5, how clear and interesting was the information provided about marine life (e.g., fish diets, fun facts)?

15 responses



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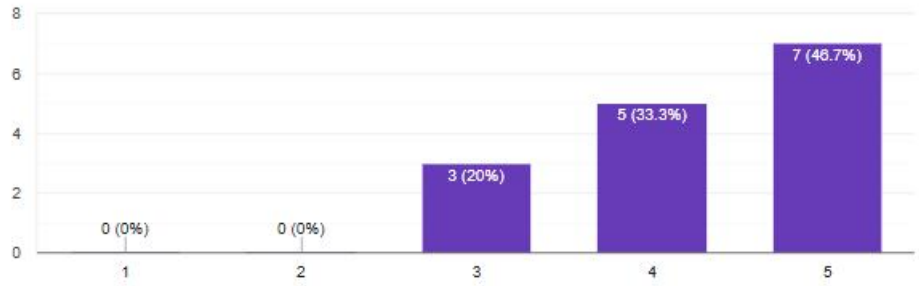
Engagement in Learning (Part 2)

On a scale of 1 to 5, was the educational information presented in the game easy to understand?

15 responses



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Impact on Awareness

Did playing 'Ocean Explorer' increase your interest in marine life?

If Yes, please briefly explain why:

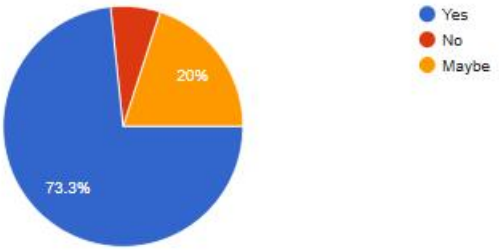
15 responses

Copy chart

Feedback

Did the feedback provided after quiz questions (e.g., showing correct answers for your incorrect attempts) help you understand the correct information?

15 responses



Section 4 : Non-Functional Test Cases

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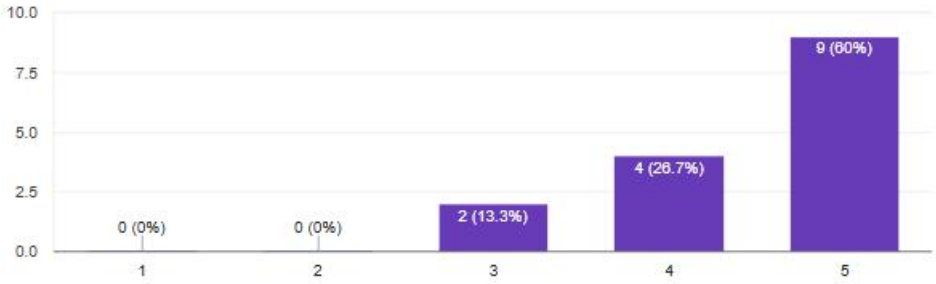
Usability

On a scale of 1 to 5, how easy was it to navigate the game's menus and interface without any prior instructions?

15 responses



Copy chart

Performance

During your gameplay (especially if you played for 10+ minutes), did you experience any significant lag or crashes?

If Yes, please describe when and where it occurred:

15 responses

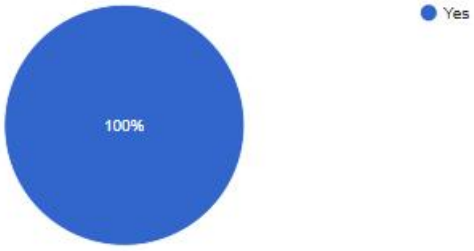
Copy chart

Compatibility

Did the game install and run correctly on your device without major UI scaling or control issues?

If No, please describe the issues you encountered:

15 responses

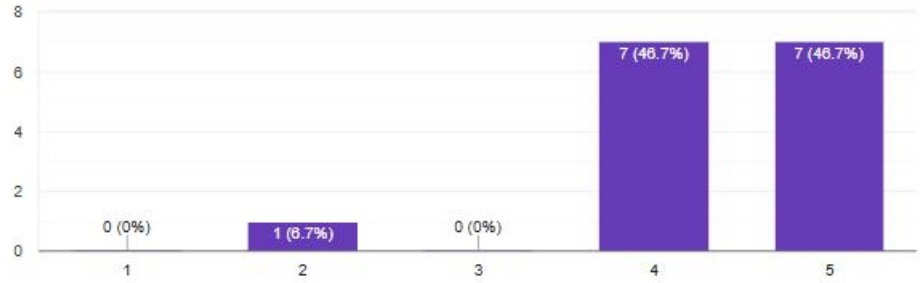


Section 5 : Overall User Satisfaction & Feedback

On a scale of 1 to 5, what is your overall satisfaction with the 'Ocean Explorer' game?

Copy chart

15 responses



What did you like **most** about the 'Ocean Explorer' game?

15 responses

That it is interactive, and has encyclopaedia that enabled me to learn regarding the fishes, and it has quizzes and games that tested my knowledge, challenging me to do better in each stages.

About fish

Different types of mini games

the first quiz

Variety of fish

About that character

Can leam about fish

Explore more about fish

The ocean

What did you like **least** about the 'Ocean Explorer' game?

15 responses

The 'swimmer' visual was too pixelated.

Graphics

the first quiz

Need more fish

Need more kind of fish

Nothing

Graphics are satisfactory

Explore fish

the puzzle. I feel like the first puzzle is a very niche puzzle that not many would like to play. and because of that I couldn't finish the game so for smth like this it's better to have a minigame selection rather than make the players play something difficult immediately after the exploration

Please describe any issues you encountered during your experience.

15 responses

No

No issue

overall good

No issues.

cant pass the first quiz(my fault heh;-;)

nothing

For now none

No issues

Overlapping title on first run
I couldn't get past the first puzzle

Do you have any other comments or suggestions for improving 'Ocean Explorer'?

15 responses

Maybe the 'user' can be pre-set fish/other items that explores the ocean. Maybe a fish that explores another fish (since the visual for the fish was really clear), or a camera that explores the ocean as the 'human swimmer' visualization may be hard to do.

Add more elements in the ocean

maybe sorting the quiz order?

Can add more kind of fish that have in specific county.

Can add other lake or pond

Graphics can be improve

Can add more fish

Please either have a minigame level selection or have something easier for the first puzzle. Unless your game was meant to be the push around the piece to fix the picture kind of puzzle, it's not exactly the best learning journey (but maybe it's just bc I was stuck)